APR 19 PERIOD LIBRARY

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879

VOL. XXII NO. 12 | SAN FRANCISCO, MARCH 20, 1909 | PER COPY, 10 CENTS

ELECTRIC APPLIANCE COMPANY — THE QUICK SHIPMENT HOUSE

726-728-730 Mission Street
San Francisco

OKONITE WIRE

OKONITE — TRADE MARK REG. U.S. PATENT OFFICE

THE STANDARD for RUBBER INSULATION

Okonite Tape, Manson Tape,
Candee Weather-Proof Wire,
Candee (Patented) Potheads.

THE OKONITE COMPANY, LTD.

253 Broadway NEW YORK

PARANITE

INDIANA RUBBER AND INSULATED WIRE CO.

Manufacturers of Paranite and Peerless Rubber Covered Wires and Cables
Underground, Aerial, Submarine and Inside Use
Telephone, Telegraph and Fire Alarm Cables
All Wires are Tested at Factory JONESBORO, IND.

Electric Appliance Company
728 Mission St., San Francisco Pacific Coast Agents

Standard Underground Cable Co.

MANUFACTURERS OF

BARE AND INSULATED WIRE AND CABLES

Chicago Pittsburg Philadelphia Atlanta
New York Boston St. Louis San Francisco

PACIFIC COAST DEPT. --- A. B. Saurman, Manager
Sub-Office—Los Angeles, Cal. Shreve Bldg., San Francisco

Phillips Insulated Wire Co.

PAWTUCKET, R. I.

INSULATED WIRE TRADE MARK "O.K." AND CABLES

"O.K." WEATHERPROOF
"PARAC" RUBBER COVERED

BLACK CORE TRADE PARAC MARK RUBBER WIRES

COMPLETE STOCKS CARRIED BY
OUR PACIFIC COAST AGENTS

California Electric Co. LOS ANGELES
Electric Appliance Co. SAN FRANCISCO
Western Electric Co. SEATTLE

Specify....

BROOKFIELD GLASS INSULATORS

The Standard

PACIFIC METER CO.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

301 SANTA MARINA BUILDING
California and Drumm Sts. San Francisco

VULCAN ..... Refrigerating and Ice Making Machinery

MANUFACTURED BY

VULCAN IRON WORKS

Office: 702 Atlas Bldg., 604 Mission St.
Works: Francisco and Kearny Streets San Francisco

FOR INDEX TO ADVERTISEMENTS SEE PAGE EIGHT

THE STANDARD

Kearny 1077

Fans
Lamps
Phones
Carbons
Switches
Condulets
Insulators, etc.

ELECTRICAL WORKS

San Francisco Cal.

STERLING

"The Modern Electric Supply House"

WHOLESALERS OF

Electrical Supplies

COMPLETE STOCK OF

Telephones
Gas Lighting Supplies
Telegraph Instruments
Wireless Receivers
Klein's Tools
Cedar Poles and Construction Material
Highland Paste
Allen's Paste
Gas Engine Igniters
Jump Spark Coils
Storage Batteries
Arc Lamps
Arc Light Carbons (Columbia and Electric Brands)
Soldering Flux (For Soldering Aluminum Wire, Etc.)
Unmounted Switches
Pull In Junction Boxes

We have many others.—Write for our General Supply Catalog

Sterling Electric Company

133-139 New Montgomery St., San Francisco Phone Kearny 2591

Standard Tungstens

ARE THE BEST

25 Watt Standard Base
40 " "
60 " Skirted "
100 " " "

HAVE YOU OUR NET PRICES?

IMMEDIATE DELIVERIES

California Incandescent Lamp Co.

661 MISSION ST., SAN FRANCISCO

J. T. Thorpe & Son

BRICK CONTRACTORS

Boiler and Furnace Work a Specialty

525 A Street, San Francisco PHONE, PACIFIC 2476

"George Cutter's Double Two"

KLEIN'S

New Electrician's Pocket Tool Kit

¶ This tool-kit contains a selection of Klein tools such as have been found indispensable to the practical telephone man.

¶ It is of convenient pocket-book style, with a firm metallic clasp.

No. 403 K

Special Prices Quoted on Request.

Send 3c. in Stamps for 65 Page Catalogue.

Mathias Klein & Sons

95 W. Van Buren Street Chicago, Ill.

BROOKS-FOLLIS

ELECTRIC CORPORATION

Siemen's Arc Light Carbons

Also General Stock of Electrical Supplies

44-46 SECOND ST. SAN FRANCISCO

PHONE KEARNY 1800

SIMPLEX

SPECIAL CONDITIONS Met by SPECIAL DESIGN

Prompt Attention

INSULATED WIRES and CABLES RUBBER — CAMBRIC THE SIMPLEX ELECTRICAL CO. BOSTON

ALL TYPES RUBBER INSULATED

WIRES and CABLES

Telephone-Electric Equipment Company

Pacific Coast Sales Agents

612 HOWARD STREET SAN FRANCISCO

SEATTLE LOS ANGELES

SIMPLEX

For Suburban Underground Connections Use Steel Taped Lead Covered Cables No Conduit—Quickly Installed Few Joints

INSULATED WIRES and CABLES RUBBER — CAMBRIC THE SIMPLEX ELECTRICAL CO. BOSTON

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXII. SAN FRANCISCO, MARCH 20, 1909 NUMBER 12

LIGHTING WITH METALLIC FILAMENT LAMPS.[1]

BY E. L. SHERWOOD.

The incandescent lamp industry, during the twenty-eight years since the lamp was invented, has had a remarkable growth. In 1880 the number of lamps made and used in the United States hardly exceeded 25,000, while in the last year there have been between fifty and sixty million lamps used in the United States alone, while the number of lamps in the world total over one hundred millions. Assuming the average price of the lamp as 15 cents for the carbon, this gives a total of over fifteen million dollars annually paid for this one detail of electric lighting service. The tale becomes more interesting when we consider that, for the entire world, including the value of the new tungsten lamps, the total annual expenditure for incandescent lamps amounts to between twenty and twenty-five million dollars, which is a most instructive illustration of the great value of the electric industry.

An idea of the large number of varieties and types of lamps on the market today may be secured from the table, Fig. 1. In the table those marked with an "x" are giving way to the tungsten.

It has been frequently pointed out that the incandescent lamp was practically a perfect invention, as in the twenty-eight or thirty years of active use the essential features of the lamp remained unchanged. It was at first, as it is now, simply a filament placed in a glass bulb from which the air had been exhausted, with conducting wires connected to the filament running through the end of the bulb to what is known as the base. To these features nothing has been added or taken away, and although numerous patents have been taken out to change the lamp, these features still remain in the present carbon lamps and also unchanged in the new metal filament lamps. In point of fact, these new metal filament lamps are practically identical with the present carbon lamps except in respect to the filament and filament mounting.

It is therefore in the filament, the light-giving portion or burner, that we must look for the radical improvement in efficieny which the new lamps secure. The conditions required in the filament are that it must be capable of standing a very high temperature and be a conductor of electricity—conditions fulfilled by a very few materials—carbon and a few metals. The earliest lamps were made with metal filaments—of platinum, which at the time was the only suitable metal practically available. The requisite temperature for the filament is, however, well above the melting point of platinum, and this metal gave way, therefore, to carbon as a very much more refractory as well as a much less expensive filament material. Carbon filaments greatly improved have since remained the standard filaments for incandescent lamps until the advent of the new tantalum and tungsten filaments.

It is of interest here to note that tungsten was available at the time the incandescent lamp was first invented, and yet could not be utilized at that time because no one knew how to make a wire or filament of it. It is very questionable, anyway, whether such a filament would have been made practical at that stage of the development, as it requires all the experience gained in the carbon lamp development to make a practical tungsten lamp today. The problem of making a filament of tungsten has been solved in somewhat of an analogous way to that evolved for making carbon filaments. The early carbon filaments were made from strips of cardboard and pieces of silk or thread, but chiefly of split bamboo, the material Edison selected as the most suitable of the natural fibres.

Then the cellulose process was evolved by which the ordinary cotton or paper was mixed and dissolved in a solution which produced a cellulose syrup or paste. In this form the material could readily be squirted through a die in a uniform thread of any desired size, which, when dried, gave an ideal fibre for carbonizing into a filament. These are then carbonized and treated and cut into the proper lengths.

Fig. 3 shows the lamp in its various stages of development. On the upper portion of the slide we see first the filament as it is cut to length, then the glass mount, the leading-in wires, and then the process of placing these three sections together in the mounted filament. In the lower row of figures we see first the lamp bulb as it comes from the lamp manufacturer. The first operation is to cut off the lower end of this, also to open a hole in the top and attach a tube of glass. This is what is known as tubulating the lamp. The mounted filament is then inserted through the lower opening and sealed in with an air-tight joint all around. The air is then exhausted and the tube melted off the top of the lamp, forming the tip. The lamp is then based, the leading-in wires cut off and soldered to the base in the proper way. After this operation the lamps are photometered, cleaned, marked and packed.

Owing to the peculiar nature of the metal tungsten, the filaments are not made by drawing a wire, but are formed by the agglomeration process; that is to say, the filaments are built up from a fine powder and by certain processes are brought into a form of homogeneous metallic filament. The filament so obtained is of a slightly gray color, and consists of hairpin loops of varying lengths, according to the size of bulb and candle power of the lamp.

The general process of mounting a tungsten filament in the bulb and completing the lamp are similar to those employed for the carbon lamp, except that much greater care in handling must be employed than is necessary with the carbon. The mounting of the filaments is an example of the greater care that is required with the tungsten filament. In the carbon lamp the filament is mounted and secured to the leading-in wires by carbon paste and the processes of doing this have been so improved that this pasting can be done by machinery. In the case of the tungsten filament the filament is welded to the connecting wires, which weld is formed by an electric arc by hand. In the four-filament lamp there are eight of these filament welds, which must be executed with great care by special hand work.

[1]Paper read before San Francisco Section, American Institute of Electrical Engineers, January 22, 1909.

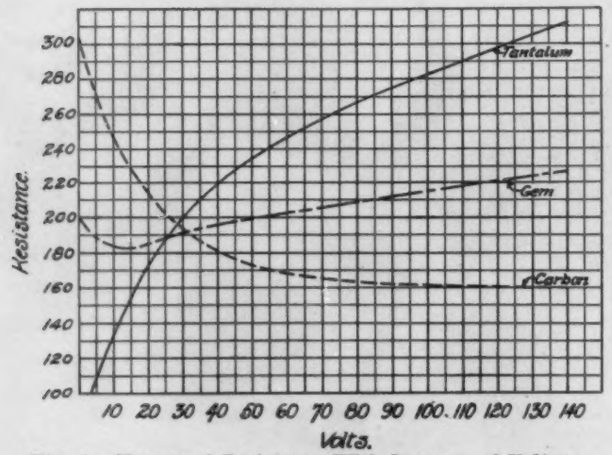


Fig. 4. Change of Resistance With Increase of Voltage.

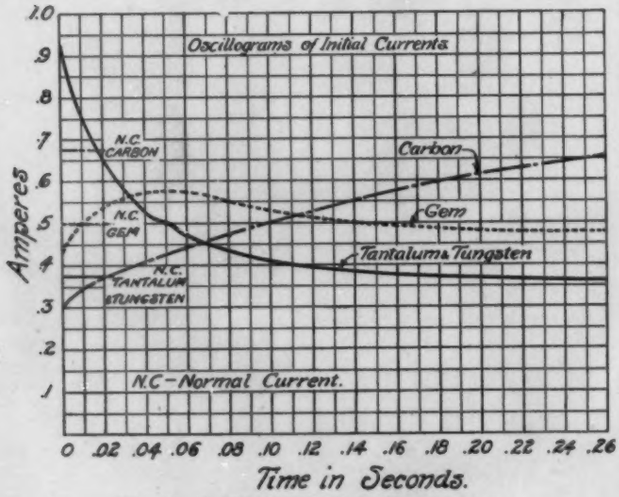


Fig. 5. Oscillograms of Initial Current.

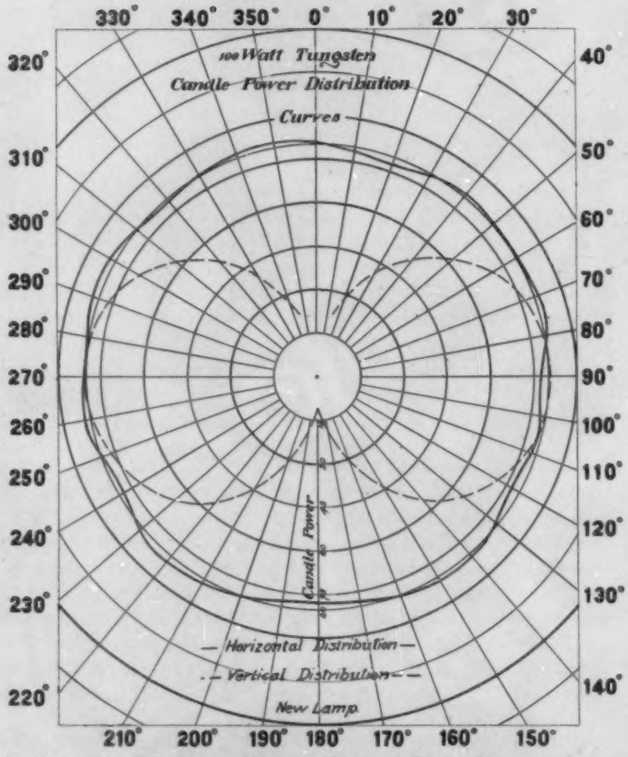


Fig. 6. Candle Power Distribution on Both Horizontal and Spherical Planes for Tungsten Lamp.

In the 100-watt tungsten lamp filament the total length of the four filament loops is 28" of a diameter of about .003". The filaments employed in the various sizes of lamps ran from .001" in diameter to about .005½" and larger. How delicate the filament of the 25-watt lamp is with its .001" diameter is hard to appreciate, but one can understand how fine this gossamer fibre is

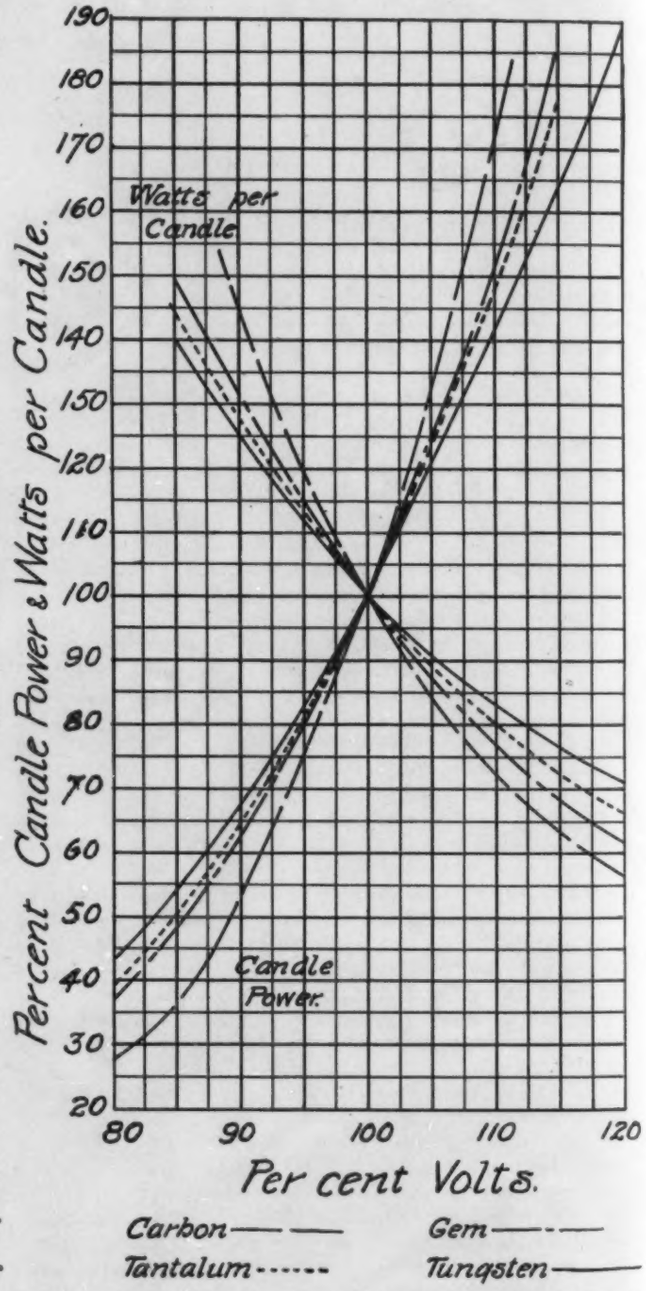


Fig. 7. Change of Watts per Candle and Candle Power Due to Change of Voltage.

when reminded that the hair of the human head has a diameter three times as great. In the manufacture of the 25-watt tungsten lamp, besides the bottom supports, to which the filament is welded with eight welds, and the four supporting anchors, there are eight middle loops, forming for each lamp twelve wire loops and anchors, which means for every thousand lamps there must be twelve thousand such loops and anchors provided.

Before passing to the commercial features in advantage of the

TABLE 1.
Changes in Candle Power and Watts Per Candle Due to Change in Voltage.

	CARBON			GEM			TANTALUM			TUNGSTEN		
	% V.	% C. P.	% W. P. C.	% V.	% C. P.	% W. P. C.	% V.	% C. P.	% W. P. C.	% V.	% C. P.	% W. P. C.
Under Voltage.	80	28		80	36		80	39		80	43	
	85	36		85	47.3		85	49.3	144.5	85	53.1	140.3
	90	52.3	145.0	90	62.0	131.8	90	64.0	128.0	90	67.0	126.0
	92.5	62.6	132.0	92.5	70.2	123.7	92.5	72.0	120.5	92.5	75.0	118.9
	95	76.0	120.0	95	79.6	115.5	95.0	80.7	113.4	95	82.9	112.0
	97.5	87.1	109.6	97.5	89.1	107.5	97.5	89.7	107.0	97.5	91.2	106.5
	100	100	100	100	100	100	100	100	100	100	100	100
Over Voltage.	102.5	115	91.8	102.5	112	93.5	102.5	111.3	94.0	102.5	110	95.4
	105	130.5	84.3	105	124.1	87.5	105	122.8	89.2	105	120	91.7
	107.5	149.0	77.2	107.5	138	82.3	107.5	135	84.6	107.5	130.4	86.8
	110	169.2	71.5	110	152.7	77.3	110	148	80.1	110	141.6	82.9
	115		63.0	115	185.5	68.2	115	177.7	74.3	115	164	76.2
	120		56.4	120		61.6	120		66.0	120	188	71.0

tungsten lamps, it would be of interest to consider some of its technical characteristics, which we can perhaps better understand when we contrast them with the same characteristics of the well-known carbon lamps.

First it will be interesting to compare with the relative lengths and diameters and surface of filaments of the various lamps:

Filament.	Length Inches.	Diameter	Projected Areas Square Inches.	C. P. Per Sq. Inch of Projected Area.
Carbon 25 c. p.....	9.4	.0060	.0564	443
Metallized 20 c. p.....	9.5	.0037	.03515	570
Tantalum 20 c. p.....	23.4	.0018	.04212	474
Tungsten 100 w., 80 c. p.	28.	.0029	.0812	98.5

The resistance characteristics of metal filament lamps such as tungsten are the reverse of those of carbon, and Fig. 4 illustrates the law of change of resistance with increasing temperature or voltage for the different types of filament. As a result of this resistance characteristic, there is a very interesting difference in current flow of the different lamps when the current is turned on. This is shown in the oscillograms of the initial currents of the different lamps as illustrated in Fig. 5, as given by Prof. Amrine of the University of Illinois.

The candle power distribution on both horizontal and spherical planes is shown for the tungsten lamp in Fig. 6. The ratio of mean horizontal candle power to mean spherical candle power, or what is known as the spherical reduction factor, is approximately in the new lamps as follows: Carbon, .810; metalized, .803; tantalum, .787; tungsten, .79.

This factor does not vary very much for the carbon, metalized or tungsten lamp during life, but changes in the tantalum, giving a higher ratio at the end of life than at the beginning, due to the change in the structure of the filament.

The relative life and candle power performance, that is, the change in candle power during life, and also the change in total watts and watts per candle power, are given in Fig. 7. for the different lamps. This shows remarkably long life for the tungsten lamp, with its high efficiency well beyond that obtained for the carbon, except at the lower efficiencies.

The relative variations in watts per candle and candle power with change in voltage for the different lamps are given in Fig. 8 and Table No. 1.

The efficiency of the lamp as a producer of light in common with other forms of lamps is very low. The carbon incandescent lamp has a better efficiency than any other commercial form of lamp, except the arc light, and for the ordinary carbon lamp the light-giving efficiency runs about 3½ per cent., that is, 96½ per cent., of the energy consumed by the lamp is wasted in heat and non-luminous vibrations, and only 3½ per cent. given out in luminous vibrations.

This has been increased by the new tungsten lamps to about 8 per cent., which is quite a material gain, considering the importance of the efficiency of the lamp, which is placed, so to speak, at the peak of a pyramid to receive the very small portion of energy which remains from the coal after the losses in boiler, engine, dynamo, transmitting line, etc., have been subtracted.

It will be of interest here, perhaps, to consider how the efficiency of light production is increased with the new tungsten filament lamps. The diagram Fig. 10 gives the energy in the various regions of the spectrum for the various temperatures. The white space shows the luminous portion of the spectrum and the shaded portion the non-luminous vibrations. It will be seen that as the temperature is increased a larger proportion of the energy, as shown by the different curves, is thrown into the luminous part of the spectrum; therefore the higher the temperature the greater is the proportion of luminous to non-luminous vibrations.

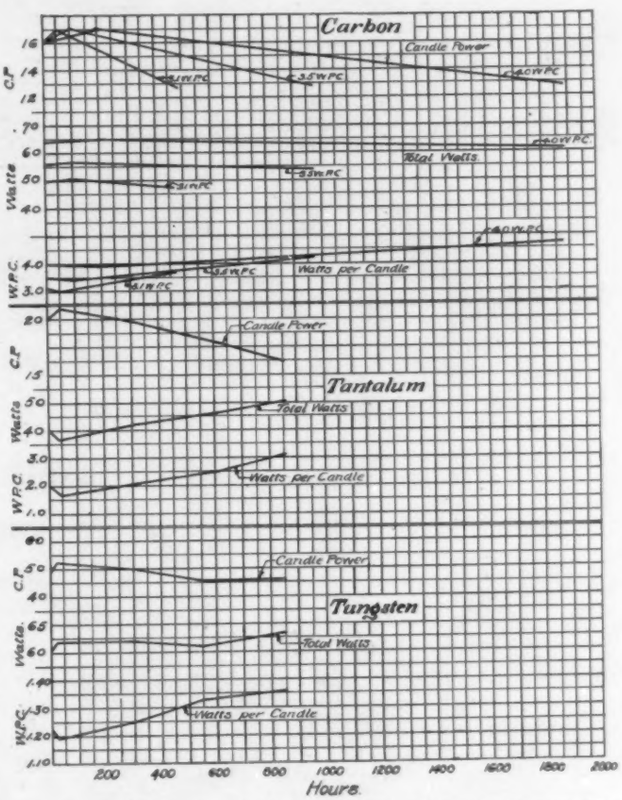


Fig. 8. Variations in Watts per Candle and Candle Power With Change of Voltage.

Some of the gains in efficiency also result from a selective radiation of tantalum and tungsten; that is, such metals give a higher ratio of luminous to non-luminous radiations at the same temperature than is given by the ordinary carbon filament.

The marked gain in efficiency which results from increase in temperature is indicated by the fact that, at the working temperature of these metal filament lamps, the intensity of light emitted varies about as the twelfth power of the temperature, while the electric power supplied to the filament varies about as the fifth power of the temperature.

The tungsten lamp has now been on the market for a little over a year and over six million American-made tungsten lamps

have been sold and placed in service. It is a remarkable manufacturing record which the past year has given in the matter

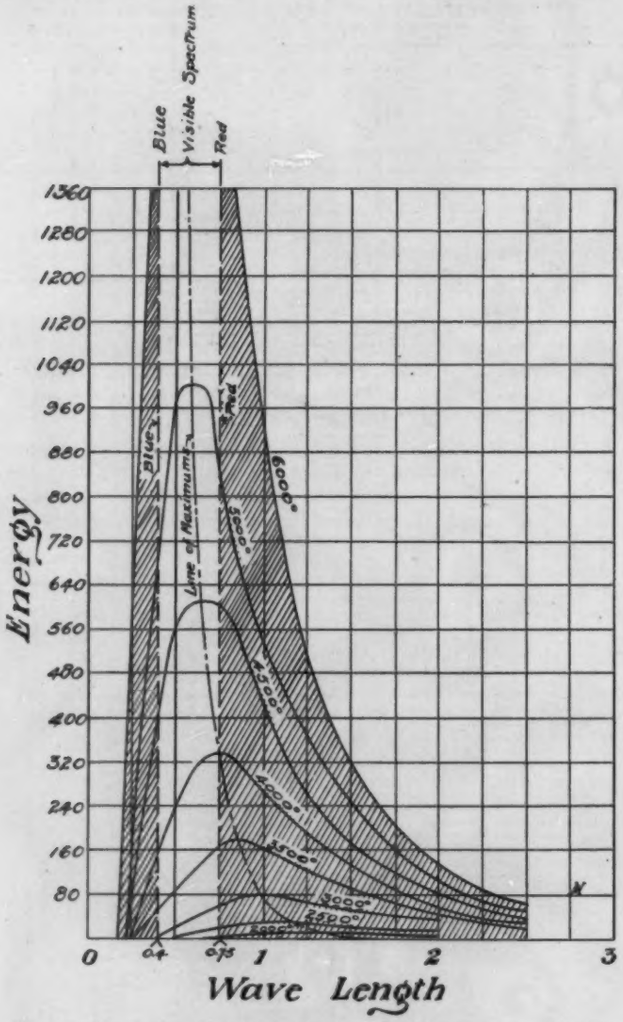


Fig. 10. Energy in Various Regions of Spectrum for Various Temperatures.

of development of the tungsten lamps, when we consider how many years it took to develop the carbon filament lamp and then consider that in practically one year the present tungsten lamps have been developed with their excellent life performance and service results, and the many innumerable difficulties attendant on a new development that have had to be overcome so as to make the lamp, with its very fragile and delicate filament, commercially practicable, not only in the laboratory, but as a regular product to be shipped and handled. With all, this production has been brought up to the point where over 40,000 finished lamps per day are being produced.

Table 2 is a comparison showing minimum costs to the largest purchasers with the relative values of the different lamps as shown.

In Fig. 11 we have an illustration of diagram showing costs of producing 100 candle hours of light for the different lamps, which graphically indicates where each lamp qualifies as the most economical producer of light, considering the cost of power and cost of renewals.

In Fig. 12 we have graphically shown the saving secured by the 100-watt tungsten, and the rate at which it pays its first cost.

TABLE 3.

Tungsten vs. Carbon Lamps.

Hours of Life to Save Full Cost of Tungsten Lamp at 10c per K. W. Hour.

	20 c. p.	32 c. p.	48 c. p.	80 c. p.	200 c. p
Carbon lamps consume in watts	62	100	150	250	620
Tungsten lamps consume in watts	25	40	60	100	250
Watts saved by Tungsten	37	60	90	150	370
Value of saving per hour at 10 cents per k. w. hour	$0.0037	0.006	0.009	0.015	0.037
List price of Tungsten lamp	0.85	1.10	1.40	1.75	3.50
Hours life to repay cost of Tungsten	230	183	155	116	94.6

It will be noted that for 800 hours life assumed for the Tungsten, the following is true:

25 watt Tungsten saves its first cost 3 times over.
40 watt Tungsten saves its first cost 4.4 times over.
60 watt Tungsten saves its first cost 5 times over.
100 watt Tungsten saves its first cost 7 times over.
250 watt Tungsten saves its first cost 8 times over.

In Table 3 is shown the hours' life required to save the full list cost of the tungsten as compared to equal candle power of carbon lamps at the 10-cent rate per k. w. hour.

TABLE 4.

Central Station Lamp Charge which Customer could pay without loss, for the various types of lamps, assuming in each case that he can obtain the carbon lamps on free renewal.

TYPE OF LAMP.	Assumed rate per Kw. hour.	Assuming that one new type lamp replaces each 16 c. p. carbon lamp.	Assuming that one new type lamp replaces each 32 c. p. carbon lamp.	Assuming that enough new types lamps are used to furnish as 16 c. p. service as 16 c. p. carbon lamps.
20 c. p.	5c	$1.25		$1.85
	7½c	1.875		2.775
25 watt	10c	2.50		3.70
Tungsten	15c	3.75		5.55
32 c. p.	5c	.50	$3.00	$3.00
40 watt	7½c	.75	4.50	4.50
Tungsten	10c	1.00	6.00	6.00
	15c	1.50	9.00	9.00
48 c. p.	5c		$2.00	$4.50
60 watt	7½		3.00	7.00
Tungsten	10c		4.00	9.00
	15c		6.00	13.50
80 c. p.	5c			7.50
100 watt	7½c			11.25
Tungsten	10c			15.50
	15c			22.50

In Table 4 we show the price which the customer could afford to pay for the various tungsten lamps with the carbon lamps furnished free. These results are also shown in Fig. 13.

TABLE 2.

Comparison of Carbon, Tantalum and Tungsten Lamps and Service at Minimum General Prices.

	CARBON	TANTALUM		TUNGSTEN			
	50 W.—16 c. p.	40 W.	25 W.	40 W.	60 W.	100 W.	250 W.
Assumed life	500	800	800	800	800	800	800
List Price—20%, 15% and 10% Dis.	.136	.34	.52	.673	.8568	1.071	2.142
k. w. hours during life		32	20	32	48	80	200
Cost of renewals per k. w. hour	.55c	1.06c	2.6c	2.1c	1.79c	1.34c	1.07c
Candle hours during life	7350	14,720	15,000	23,680	35,580	60,000	150,000
Cost of power per 100 candle hours @ 10c per k. w. hour	3.4c	2.17c	1.33c	1.33c	1.33c	1.33c	1.33c
Cost of renewals per 100 c. p. hours	.185c	.231c	.347c	.204c	.241c	.179c	.143c
Total cost of power and lamp renewals per 100 c. p. hours	3.585c	2.401c	1.677c	1.614c	1.571c	1.509c	1.473c
Cost of power per 100 hours of service @ 10c per k. w. hour	50c	40c	25c	40c	60c	$1.00	$2.50
Total cost of power and lamp renewals per 100 hours of service	52.72c	44.25c	31.50c	48.42c	70.71c	$1.134	$2.768

TABLE 5.

Minimum Rate for Current at which the Customer can begin to afford to buy the several types of lamps at the price indicated. Assuming that he now gets free renewal of the Standard 16 c. p. Carbon Lamps.

TYPE OF LAMP.	Assumed central station charge for lamp.	kw. hour rate at which lamp pays for itself If it replaces a 16 c. p. carbon lamp.	kw. hour rate at which lamp pays for itself if it replaces a 32 c. p. carbon lamp.	kw. hour rate at which lamp pays for itself If it replaces enough 16 c. p. carbon lamps to furnish equal candle power.
20 c. p. 25-watt Tungsten.	$ .85	3.4c		2.30c
	.60	2.4		1.6
32 c. p. 40-watt Tungsten.	.75	7.5c	1.25c	1.25c
	1.10	11.00	1.83	1.83
48 c. p. 60-watt Tungsten.	.90		2.25c	1.0c
	1.40		3.5	1.55
80 c. p. 100-watt Tungsten.	1.10			0.733c
	1.75			1.16
200 c. p. 250-watt Tungsten.	2.25			0.565
	3.50			0.875

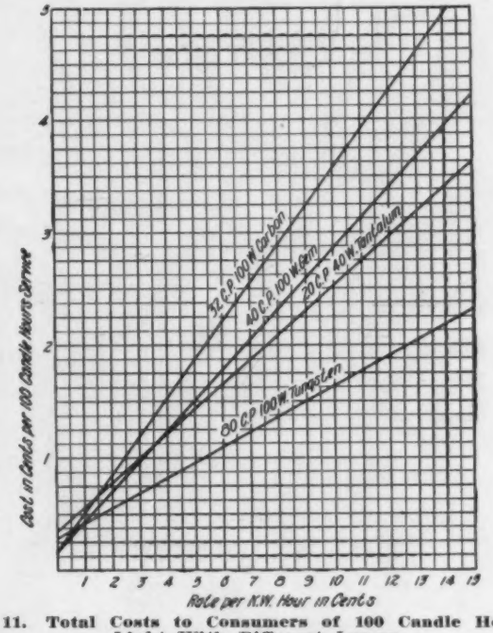

Cost in Cents per 100 Candle Hours Service
Rate per K.W. Hour in Cents
32 C.P. 100 W. Carbon
40 C.P. 100 W. Gem
20 C.P. 40 W. Tantalum
80 C.P. 100 W. Tungsten

Fig. 11. Total Costs to Consumers of 100 Candle Hours of Light With Different Lamps.

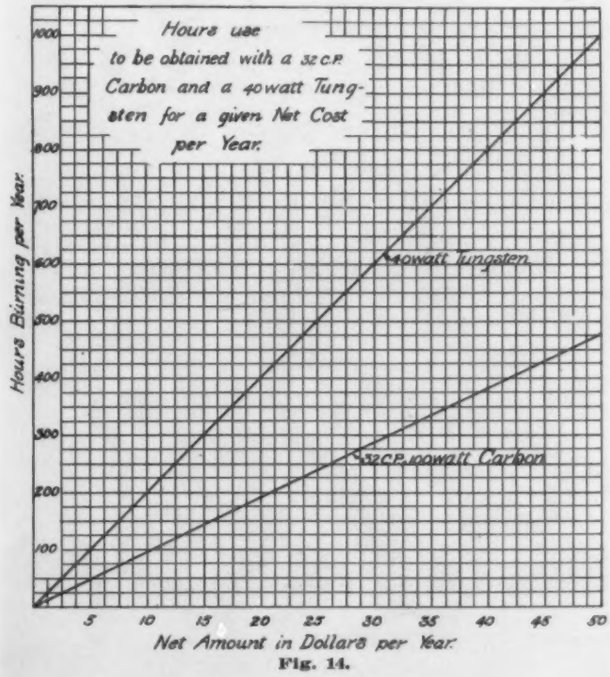

Hours use to be obtained with a 32 C.P. Carbon and a 40 watt Tungsten for a given Net Cost per Year.
Hours Burning per Year.
40 watt Tungsten.
32 C.P. 100 watt Carbon.
Net Amount in Dollars per Year.

Fig. 14.

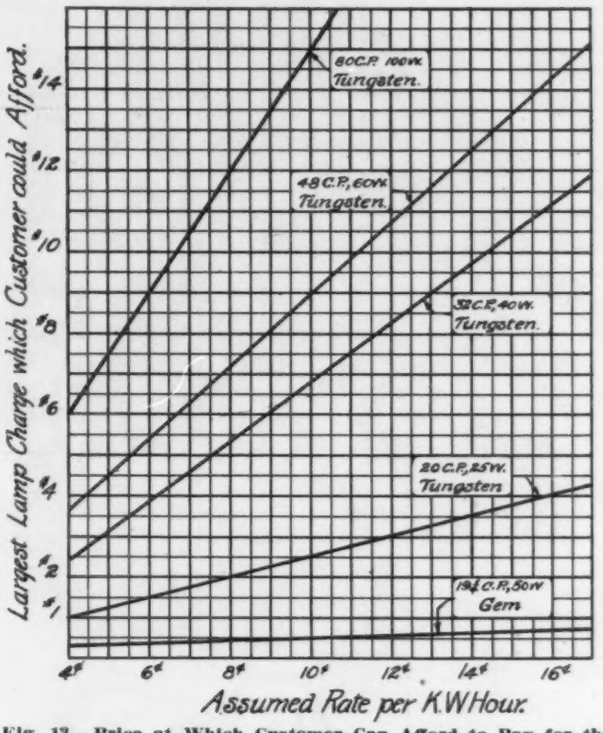

Largest Lamp Charge which Customer could Afford.
80 C.P. 100 W. Tungsten.
48 C.P. 60 W. Tungsten.
32 C.P. 40 W. Tungsten.
20 C.P. 25 W. Tungsten
19½ C.P. 50 W. Gem
Assumed Rate per K.W. Hour.

Fig. 13. Price at Which Customer Can Afford to Pay for the Various Tungsten Lamps With the Carbon Lamps Furnished Free.

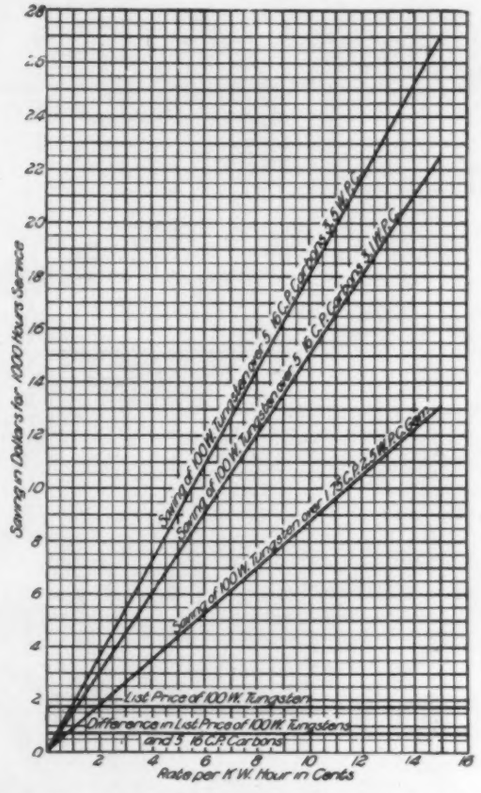

Saving in Dollars for 1000 Hours Service
Saving of 100 W. Tungsten over 5 16 C.P. Carbons at 3.1 W.P.C.
Saving of 100 W. Tungsten over 5 16 C.P. Carbons at 3.5 W.P.C.
Saving of 100 W. Tungsten over 3 32 C.P. 4 W.P.C. Carbons
List Price of 100 W. Tungsten
Difference in List Price of 100 W. Tungsten and 3 16 C.P. Carbons
Rate per K.W. Hour in Cents

Fig. 12. Saving in Current Cost for Equal Illumination With 100 Watt Tungsten Over Other Lamps at Various Rates per k. w.

In Fig. 14 is shown a diagram of the number of hours' use obtainable for a given annual cost for the 32 c. p. carbon and the 32 c. p. tungsten.

Table 5 shows the minimum rate per k. w. hour for current at which the various lamps pay their full cost.

Fig. 1. Standard Types Large Incandescent Lamps for Multiple Service.

	Volts.	CARBON. 3.1-4 w. p. c. C. P.	Watts.	Bulb.	GEM. 2.5 w. p. c. C. P.	Watts.	Bulb.	TANTALUM. 2.0 w. p. c. C. P.	Watts.	Bulb.	TUNGSTEN. 1.25 w. p. c. C. P.	Watts.	Bulb.
Regular 95-250 Volts.	95-130 Volts.	2	4.8-6	SS14									
		4	4.8	SS17									
		6	3.7-4.3	SS17									
		8	3.1-4	SS17									
		10	3.1-4	SS17									
		12½	3.6-4	SS17									
		16	3.1-4	SS19									
		16	3.5-4	PS21	16	40	SS19	12½	25	SS19	20	25	SS19
		20	3.0-3.5	SS19	20	50	SS19	20	40	M19	32	40	SS21
		24	3.1	SS19	32	80	SS24	25	50	M19	32	40	ST21
		20	4	SS24	40	100	B25	40	80	ST24½	48	60	ST24½
		25	3.6-4	SS24	50	125	SS30				80	100	SS30
		32	3.1-3.6		75	187	SS35				200	250	ST40
					100	250	SS40						
	200-250 Volts.	5	6	BTH19									
		8	4.4	BTH19									
		16	3.4-3.8	PS21									
		20	3.8	PS21									
		24	3.8	PS21				25	50	ST21			
		32	3.8	SS24				40	80	SS30			
		50	3.8	SS25				80	160	SS30			
		100	3.8	SS35									
Irregular 95-130 Volts.	Round.	4	4.8	G18½				Round Bulb.					
		8	4.1	G18½									
		10	3.6	G18½									
		16	3.5-4	G18½				12½	25	G18½			
		16	3.5-4	G25									
		32	3.6	G30									
		50	3.6	G30									
	Tubular.	8	4.1	T10-36	Meridian Type.			Meridian Type.			Meridian Type.		
		10	3.6-4.5	T10-36									
		16	3.1-3.5	T10-36	25	50	G30	25	40	G30	40	40	G30
		32	3.6	T14-38	50	100	G40	50	80	G40	60	60	G40
	Stereopticon.	20	3.8	G20									
		32	4.0	G20									
		32	4.0	G25									
		50	4.0	G25									
		100	3.75	G30									
		Total Watts.											
	Reflector.	14.4		SSR18-16									
		35		R24-19½									
		45		R28-23									
Irregular 200-250 Volts.	Round.	8	4.4	G18½									
		16	3.8	G18½									
		16	3.8	G25									
		32	3.8	G25									
	Tubular.	16	3.8	T10-36									
	Stereopticon.	32	3.8	G25									
		50	4	G25									
		100	3.75	G30									
		Total Watts.											
	Reflector.	35		R24-19½									
		45		R28-23									
	Meridian.	60		G30									
		120		G40									

NOTE: The large number of types shown in above table is further multiplied by different bases and colors. In addition to these standard multiple lamps the variety of street series types (with carbon, Gem and Tungsten filaments), and Miniature-decorative, candelabra, battery, surgical, novelty and special lamps (with carbon, Tantalum and Tungsten filaments) present an even more formidable array.

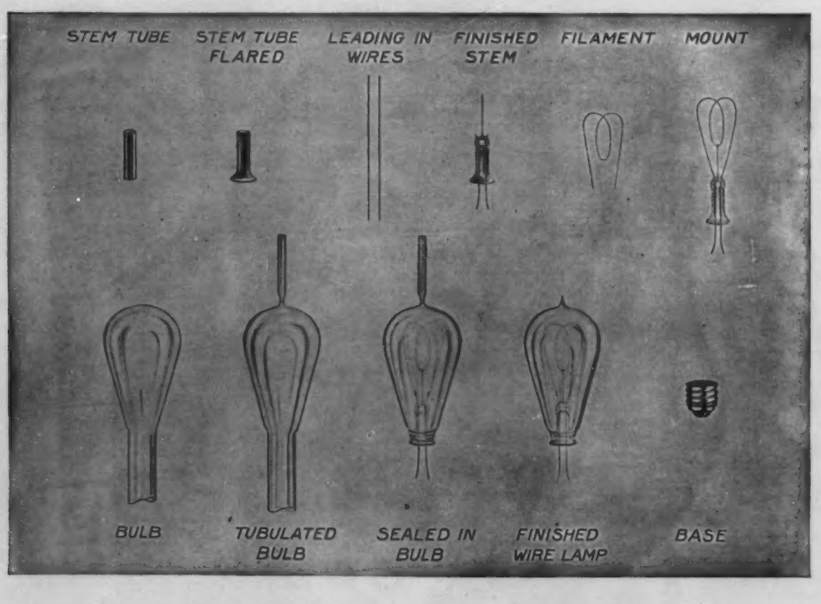


Fig. 3. Various Stages in Development of Incandescent Lamp.

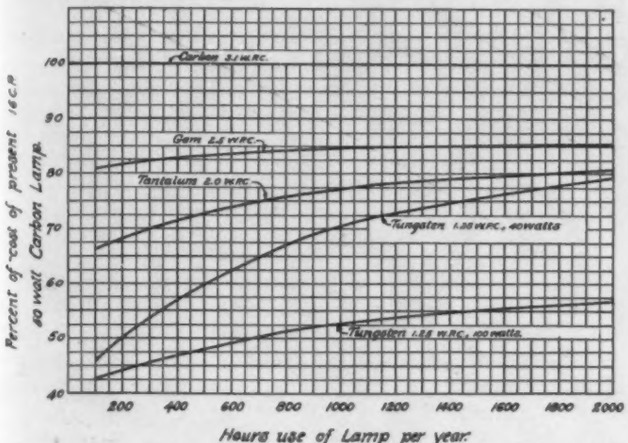

Carbon 3.1 W.P.C.
Gem 1.5 W.P.C.
Tantalum 1.0 W.P.C.
Tungsten 1.25 W.P.C., 40 watts
Tungsten 1.25 W.P.C., 100 watts
Percent of cost of present 16 c.p. 40 watt Carbon Lamps
Hours use of Lamp per year.

Fig. 15. Relative Cost of Producing a Candle Hour of Light With Carbon 3:1 w. p. c., 16 c. p. light, as 100 per cent.

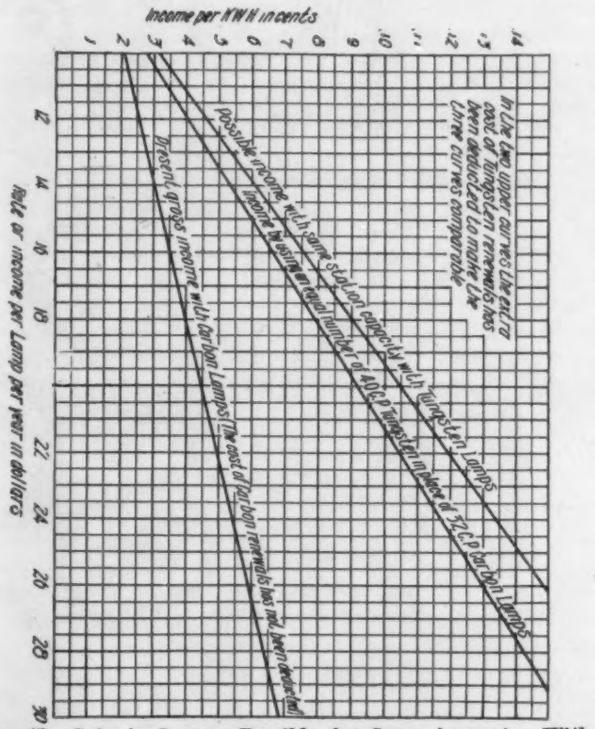

Income per K.W.H. in cents
Possible income with same stations capacity with Tungsten Lamps
Present gross income with Carbon Lamps (No cost of Carbon renewals has been deducted)
Difference between curves represents the cost of Tungsten renewals
Gain in income per Lamp per year in cents

Fig. 17. Gain in Income Possible for Same Apparatus With Tungsten Lamps.

In Fig. 15 is shown the relative cost of producing a candle hour of light with various lamps on the differential cost basis.

In Fig. 17 is shown, for series lamps, the gain in income which is possible for the same apparatus with the tungsten lamps as compared with the carbon lamps.

The 25-watt lamp has been in the field only a couple of months, and its sales already amount to nearly as much as those of the 40 and 60 watt types and will, before long, materially exceed that of any other size. The 40-watt lamp is also provided in the small standard bulb so that it will fit into the regular installations without changing any fixtures or shades, and this lamp should prove equally popular to the 25-watt size, giving, as it does, twice the candle power of the ordinary 16 c. p. carbon lamp, with 25 per cent. less energy consumption.

We have, from time to time, received very interesting reports on the life and candle power performance of the tungsten lamp, and know from these records that the life of the commercial lamp of today is remarkably long. The lamp can safely be counted upon for giving a life of approximately 800 to 1,000 hours, with candle power so well maintained that the decrease in brilliancy is not noticeable.

GERMAN MUNICIPAL ELECTRIC PLANTS.

Consul Thomas H. Norton of Chemnitz furnishes the following review of the operations of municipally owned electric plants in Germany, and the main factors ente:ing into their conduct:

Germany is making experiments in so many directions in connection with the municipalization of public utilities that the results of her experience are becoming more and more valuable for other countries. Of especial interest at present is the outcome of the widespread management by cities of generating plants for electricity, supplying current for both power and illumination.

The following table shows the net annual profit or loss of such plants in 32 cities owning and managing the entire equipment. All of these cities have populations in excess of 50,000. The figures given are for 1905, and represent the surplus, or deficit, remaining after payment of interest and deduction of the customary amounts for sinking funds and depreciation.

City—	Annual surplus
Aachen	$54,000
Altona	90,000
Barmen	21,420
Bochum	46,000
Bremen	92,000
Breslau	78,000
Kassel	31,000
Chemnitz	32,000
Koln	82,000
Krefeld	22,000
Darmstadt	13,000
Dresden	77,000
Dusseldorf	91,000
Elberfeld	10,000
Erfurt	2,000
Frankfort	330,800
Freiburg	5,000
Gelsenkirchen	3,000
Hanover	20,000
Kiel	20,000
Muhlhausen	17,000
Munchen	47,000
Nurnberg	58,000
Potsdam	11,000
Stuttgart	89,000
Wiesbaden	17,000

City—	Annual deficit
Dortmund	$62,000
Gorlitz	238
Halle	21,420
Konigsberg	5,000
Plauen	238
Posen	4,522

It is noticeable that in but few cases are surpluses of any considerable amount entered upon the balance sheets. Even in such cases experts express doubts as to whether the sinking and depreciation funds are fully adequate from a business standpoint.

Electric power for the Alaska-Yukon-Pacific Exposition, which opens in Seattle on June 1st, will be furnished from Snoqualmie Falls, 10,000 k. w. at 13,200 volts, delivered to the substation at the fair grounds, which will also care for overloads at the terminals of the street railway system. There will be 250,000 incandescent lamps used on the grounds, including a special equipment of tungsten lamps for the Fine Arts Building. A great waterfall will be illuminated by electric searchlights; electrical exhibits, including wireless communication, electric vehicles and motor boats, will be installed in the various buildings, and every endeavor made to show the most advanced stages of the art.

INTERFERENCE WITH ELECTRIC WIRES IN MOVING BUILDINGS.

BY EMERSON W. READ.
Member of the San Francisco Bar.

Some interesting decisions have arisen on the subject of moving houses along public streets. It can be readily seen that such an employment will interfere with numerous industries and practices, especially on the more prominent thoroughfares.

Seemingly, Courts have not taken a favorable view of this practice. Ingenious arguments have been found by judges against such a use of the public streets. It has been judicially said that moving houses along a public highway is not an ordinary use of the highways and is not within the rights to be enjoyed by the public in such highways. One Court saw dangerous possibilities in severing wires to allow a towering building to pass; travel will be interrupted and passengers will suffer an inconvenience not to be tolerated for such a reason. In few present-day city streets can a building worthy the name be moved any distance without necessitating a cutting of telephone, telegraph, or trolley wires.

Ordinances usually fix the elevation of wires to be strung in streets. Telegraph and telephone wires may easily be regulated. It matters little whether telephone and telegraph wires are strung at an elevation of forty, fifty, or sixty feet, but the case of trolley wires is very different. Their effectiveness depends on an elevation itself to be determined by the elevation of a car. The elevation of trolley wires cannot be so easily regulated by ordinance. When a franchise is granted the presumption follows that the trolley wires to be strung will be at an elevation which will interfere with building-moving on the streets. That the moving of buildings along streets conflicts with the usual uses of such streets (a thoroughfare for trolley wires, for example) will alone show that such a practice is no "ordinary use" of streets.

In the Fort Madison Street Railway Company case it is said, "There is no doubt but that one desiring to change the location of a house or other structure may move it along a public street, providing the conditions of the street are such that this may be done without injury to others having a prior right thereto; and provided, further, that this does not, by interfering with travel, become a nuisance." The ultimate holding in that case has been elsewhere expressed in these words: "Inasmuch as the street railway company had a franchise to run its cars in the street, and as the owner of the house could not move it as intended without occupying the company's track, destroying the trolley line, and interrupting for a considerable time the operation of its cars, it was held that he was not entitled to take the house into that street."

The rule in Ohio, as shown in Toledo, B. G. & S. Traction Company, Sterling (20 Ohio C. C. 227) seems to comprehend a right in the public to move buildings in public streets, and even in streets that are the thoroughfares of electric wires. In that case it was determined, "It would be a reasonable requirement on the part of an electric street railway company that houses should be moved across its tracks only in the night time, both for the protection of the public from any danger which might be involved in the removal or disconnection of the wires at a time when the current was on, and also to avoid injury to the company by the interruption of its travel, and the inconvenience of passengers in their transportation, and the right of the people to travel along the company's tracks in its cars."

It would be useless to name the States which have specifically held that "moving houses along a public highway is not an ordinary use of a street, and is not within the right which is enjoyable by the public in such highway." It is interesting, however, that Illinois, New Jersey and North Dakota have so determined.

The North Dakota case (Northwestern Tel. Exc. Co. vs. Anderson, 12 N. Dak. 585), now quite famous and of wide acquaintance to law writers, arose in an action brought by a telephone company to recover damages alleged to have been caused to the company's property by the defendant while moving a house through and upon the streets of the city of Grant Forks. "Was the right granted a naked permission to set poles and string wires on the streets, or was it accompanied by protection from damages by reason of other usages of the street permitted by the council for private purposes? The appellant in this case is not asking to be allowed to make an ordinary use of the streets of the city. He is, on the contrary, asking that he be permitted to use the streets in an extraordinary mode, and for an unusual purpose. It would be strange, indeed, if large buildings could be moved along the thronged streets of a city without control or restriction, and it would be equally strange if the owner of a building could destroy the property of others to enable him to move his building from one place to another. To compel plaintiff to remove its wires or repair them whenever called upon to do so by persons moving houses would add a burdensome and unreasonable condition to the ordinance under which it acts."

In Indiana the injunction was used (in Williams vs. Citizens Railway Company, 130 Ind. 71) to restrain a house-mover from cutting wires. The city ordinance required all wires to be twenty-two feet above the level of the street. The wires in question hung fourteen feet above the level of the street. The building could have passed under wires elevated twenty-two feet. The injunction was granted, regardless of these figures, on the right of the public to regular and continuous running of the street cars.

The Ordinances of San Francisco (1904) provide for moving of houses in the streets of that city. Among other provisions of the Ordinance it is required "Whenever the owner of any building intended for human occupation shall desire to remove the same along any public street he must make a written application to the Board of Public Works for permission so to do." The part of Ordinance No. 1026 applying to wiring in the streets only applies to wires belonging to the city's Department of Electricity. "Also a further sum not exceeding twenty-five dollars in coin is deposited with the Chief of the Department of Electricity to defray all expenses of said Chief of the Department of Electricity in taking charge of, removing, fixing and repairing the wires or system or any portion thereof, or any damage thereto, connected with said Department of Electricity, in consequence of the moving or removal of any house or building."

EXAMINATION FOR MECHANICAL DRAFTSMAN.

The United States Civil Service Commission announces examinations on April 14-15, 1909, to secure eligibles from which to make certification to fill vacancies as they may occur in the positions of mechanical draftsman and topographic draftsman in the Isthmian Canal Service. The entrance salaries of these positions are as follows: Mechanical draftsman, first class, $150 a month; second class, $125 a month; topographic draftsman, $125 a month; tracer, $100 a month.

YREKA, CAL.—President Jesse W. Churchill and Secretary Alex. J. Rosborough, representing the Siskiyou Electric Power & Light Company, have filed claims to 450,000 inches, measured under a four-inch pressure, of the water of the Klamath river, to be taken out at two points about half a mile distant from the present power plant on Fall creek. This spring the company will begin work on a new power plant on the Klamath river, near Ward's canyon, which is capable of developing 60,000 horsepower. The present plant at Fall creek is now developing 6,000 horsepower, which is insufficient for the present demands.

Telephone train dispatching on the Canadian Pacific Railway has been so successful between Montreal and Farnham that it has been decided to adopt it on two circuits on the western lines of the road. Ultimately it will replace the telegraph in the operation of trains.

CURRENT COMMENT

Aluminum foil is replacing lead and tin for many packing purposes, as it is non-poisonous and cheaper than tin.

A street railway strike in Manila on March 4 was promptly squelched by employing non-union Filipinos and Americans, who ran the cars under police protection.

French letter-telegrams in the first month of use totaled over seven thousand and contained nearly four hundred thousand words. These are sent at reduced rates during certain hours.

Carbon bisulphide is produced in a specially constructed electric furnace which allows a continuous run of over a year. It is a powerful solvent for gutta-percha and other organic compounds.

Cement for lining boiler furnaces with sheet asbestos may be made from fire clay mixed with silicate of soda. China clay used in the same way makes a neat job if the heat is not excessive.

Ohio independent telephone stations totaled 324,663, as compared with 307,674 in 1907, according to statistics compiled by President F. L. Beam, of the Ohio Independent Telephone Association.

Photo-telegraphy received its first practical test in the United States when the photographs of President Taft and Mr. Roosevelt were sent over the wires from Washington to New York on March 4th by the Korn apparatus, American rights for which are controlled by Collier's Weekly.

Electric power from peat-gas machines is to be furnished the region around Svedala, Sweden. A ton of peat will produce over three thousand cubic yards of gas. Peat-gas machines are said to require less than half as much fuel as steam machines for the production of a given amount of power.

German electro-chemical industries are reported to be suffering from over-production and market depression. Competition has reduced the price of aluminum to about the cost of production; the calcium carbide market is unfavorable and the iron-alloys not in demand because of the lessened steel output.

A strike of telegraph operators has interfered with the communication rendered by the Paris Bureau of the Post-office. General dissatisfaction with the government plan of promotion by the partial merit system instead of by seniority not only caused this strike but may also bring on a strike of the telephone operators.

Power plants for the locks at Gatun and Miraflores on the Panama Canal are being installed first to operate the concrete mixing and handling apparatus, and later as a reserve to operate the locks should hydraulic power fail. Six 1500 k. w. Curtis steam turbines, together with generators, boilers, oil pumps and auxiliaries are on the ground.

Steel bands as belts for power transmission can be substituted for leather or rubber, particularly with small diameter pulleys. They do not stretch nor slip, have but little wear, and run noiselessly. Tests made by Professor Kammerer, of Charlottenburg, show that ten horsepower can be transmitted by a steel band one centimeter wide and one-half millimeter thick.

Soldering aluminum has always been difficult, and contact is usually obtained by riveting or by the MacIntyre joint for wires. A formula patented by two Belgians, J. I. and Rene Wilbrin, is said to be good if the aluminum parts to be soldered are perfectly clean. It consists of a mixture of 90.6 parts of tin, 68 of zinc and 9 of copper.

Poles for telephone and telegraph use in 1907 amounted to 2,311,651, costing an average of $1.72 apiece. This represents two-thirds of the entire pole production of the country. Cedar poles constituted over two-thirds of this and chestnut nearly one-fifth. The ravages of decay are shown by the large proportion used for renewals—fully two-thirds.

A liquid microphone is used by Prof. W. Majorana in his new system of wireless telephony. A stream of acidulated water flows between a pair of platinum electrodes placed in a small tub attached to the diaphragm of the microphone. This stream fluctuates as the microphone is vibrated by the voice and thus varies the electrical resistance in accordance with the sound of the voice.

Spontaneous ignition of engine waste as experimentally investigated by Mr. Nowicki is described in a recent issue of "Gluckauf." The rise in temperature, measured as air was drawn through the greasy mixture by an aspirator was found to be about 180° C. in 2½ hours, sufficient to char the waste. It is advised that all cotton waste be burned as soon as it has absorbed its own weight of oil.

An electric anemometer has been invented by Prof. R. B. Goldschmidt of the University of Brussels. It depends upon the variation in resistance of platinum with temperature change. One wire is exposed to the wind, the other shielded, these wires forming two branches of a Wheatstone bridge. If a current of air strikes the exposed air there will be a difference of temperature which is recorded by a galvanometer.

A forest products' laboratory is to be established at the University of Wisconsin, at Madison, by the United States Forest Service. The establishment of the laboratory means the concentration of all lines of the experimental investigations of the government looking to closer and better utilization of timber and the checking of wood waste. Forest Service laboratories for timber test work at Yale and Purdue Universities and the government's wood pulp and wood chemistry laboratory in Washington will be consolidated and transferred to Madison as soon as practicable. A force of 15 to 20 timber test engineers, experts in wood preservation, wood pulp manufacture and wood distillation will have charge of the work carried on. The laboratory will have an equipment valued at not less than $15,000.

Japanese electric railways have a total length of 165 miles with 100 miles more under construction, according to Consul John H. Snodgrass. This has been done by 16 companies with an aggregate capitalization of $38,912,336. In addition to these, there are 15 companies which are not yet in working order, with an aggregate capital of $15,062,500. The import duty on electric cars and parts is 20 per cent; on electric locomotives, wheels and axles $2.35 per 132 pounds; on insulated wire and cable 20 per cent ad valorem; on incandescent lamps of 32 c. p. or less $2.90 for every 132 pounds. In 1907 the 16 companies had a reserve fund of $496,865, and the receipts had reached the enormous aggregate of $3,828,887, from which a dividend of $1,738,762, or about 7 per cent, was paid, the passenger list for that year amounting to 182,389,707 persons. Though the business has greatly increased, there has been a gradual decrease in dividends, due, it is said, to large flotations of stock.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

E. B. STRONG, President
E. M. SCRIBNER, Vice President and General Manager
A. H. HALLORAN, Secretary and Managing Editor

DIRECTORS

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

604 MISSION STREET, SAN FRANCISCO.

TELEPHONE . . . . . KEARNY 913

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	4.00
Single Copies, Current Month	each	.10
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Lighting With Metallic Filament Lamps..*By E. L. Sherwood* 221
This paper was read before the San Francisco Section of the American Institute of Electrical Engineers January 22, 1909. The discussion by the members will appear in our issue of March 27, 1909.

German Municipal Electric Plants..... 227

Electric Power for the Alaska-Yukon-Pacific Exposition.... 227

Interference With Electric Wires in Moving Buildings..... *By Emerson W. Read* 228

Civil Service Examinations..... 228

Current Comment..... 229
Aluminum Foil.
Manila Street Railway Strike.
French Letter Telegrams.
Carbon Bisulphide in the Electric Furnace.
Cement for Lining Boiler Furnaces.
Ohio Independent Telephone Statistics.
Photo-Telegraphy in the United States.
Electric Power From Peat Gas.
German Electro-Chemical Industries.
Strike of Parisian Telegraph and Telephone Operators.
Power Plants for Panama Canal Locks.
Steel Bands as Belts.
Soldering Aluminum.
Poles for Telephone and Telegraph.
Liquid Microphone for Wireless Telephony.
Spontaneous Ignition.
Electric Anemometer.
Forest Products Laboratory.
Japanese Electric Railways.

Editorial 230
A Study in Curves.

Personals 231

Trade Notes..... 231

Los Angeles Section, A. I. E. E..... 231

News of the Stationary Engineers..... 231

Trade Catalogues..... 231

Patents 232

Small Bulb 40-Watt Tungsten Lamp..... 233

Union Shallow Sectional Switch Boxes..... 233

Three Wire Generators..... 234

Cutler-Hammer Company Opens Cleveland Office..... 234

Some Recent Tangential and Turbine Water Wheel Practice. *By George J. Henry* 235

Machinery Haulage..... 239

News Notes..... 240

A Study In Curves

The baseball enthusiast furnishes a colloquial phrase, "getting on to his curves," whose implied admonition may well be heeded by every electrical man, whether engineer or salesman. In this issue is a paper on "Lighting With Metallic Filament Lamps." It was read before a body of engineers who valued it from a scientific standpoint. It traces the difficulties that have been met in the evolution of the incandescent lamp, from the crude beginning to the present perfection. It shows the delicacy of the tungsten filament and explains why this very delicacy is at present limiting its use to the lower voltages. It shows that tungsten has increased the luminous efficiency of the incandescent lamp from three and one-half to eight per cent of the total energy available in the coal pile. This is because of the high temperature and also its property of selective radiation.

The paper also contains in the form of curves the gist of long years of experimenting, so presented that any lamp salesman may explain to a customer how, where and when a certain kind of lamp will save money. These curves graphically show the strong as well as the weak points of the several filaments now used to produce electric light. With such ammunition, the salesman is fortified in his campaign of educating the public in the methods of more efficient illumination.

A little study is necessary to analyze a curve and interpret its meaning, but such study is so well repaid that it is worth the attention of every one. Any point in a curve is a geometrical representation of two numbers which have been laid off along respective reference axes. The curve is obtained by joining a number of these points. By means of such mechanical construction the mind is enabled to mentally reconstruct certain facts with a minimum of effort.

This paper has been cited merely as an example, for to-day there are but few industries whose data or statistics cannot be shown in curve form. Within the past fifty years graphical methods have come more and more into use as an aid wherever laws and rules are considered in connection with numbers. The essential facts of a great array of tabulated figures can be quickly grasped if a few of them be plotted on a diagram. The relations of the numbers are made visually apparent by the substitution of geometric figures for Arabic numerals, and facts laboriously gleaned from long tables may be pictured at a glance by means of diagrams. This economy of intellectual effort is based on the psychological fact that a picture makes a greater impression on the human mind than do figures. The new science of salesmanship is also based on psychology and finds in the picture, and especially the curve, an effective tool for clinching arguments.

PERSONAL.

W. F. Murphy, general manager of the Idaho Consolidated Power Company, is in San Francisco.

Frank W. Eastman is in San Francisco as representative of Stanley & Patterson of New York.

W. V. Whitfield of the Sterling Varnish Company of Pittsburg, Pa., was in San Francisco last week.

W. H. Dickinson has been appointed Seattle manager for the Riter-Conley Manufacturing Company, of Pittsburg, Pa.

T. W. Winsor is expert electrical aid in the department of construction and repair, Puget Sound Navy Yard, Bremerton, Wash.

T. H. Dooling of the San Francisco office of the Electric Storage Battery Company left this week for a short trip to Los Angeles.

A. T. Clark, treasurer of the American Circular Loom Company, and John R. Cole of San Francisco spent the past week fishing at Catalina Island.

R. T. Durrett, vice-president and general manager of the Coos Bay Home Telephone Company at Marshfield, Oregon, was in San Francisco this week.

S. H. Lee, formerly with the Connecticut Company of New Haven, is now with the Portland Railway, Light and Power Company of Portland, Oregon.

R. J. Andrus, formerly commercial agent for the Washington Water Power Company, is now superintendent of the Kennewick-Pasco system of Yakima Valley Power Company at Kennewick, Wash.

Henry M. Steele, who has for the past few years been with J. G. White & Company, Inc., engineers and contractors, 43 Exchange place, New York, as chief civil engineer, has resigned on account of ill health and has removed with his family from New York to Asheville, N. C.

F. N. Boyer, of the Chicago office of the General Electric Company, accompanied by Mrs. Boyer, returned from Honolulu on March 15th. Mr. Boyer has been several months on the Pacific Coast and the Hawaiian islands seeking renewed health and is planning to spend several weeks more in this vicinity, after which he will return to Chicago, where he expects to resume his duties.

TRADE CATALOGUES.

Fort Wayne fan motors are attractively portrayed and specified in Bulletin No. 1114 from the Fort Wayne Electric Works.

An attractive booklet from the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., portrays the saving of time effected by their telephone equipments.

Catalogue No. 23 from the Chicago Fuse Wire and Manufacturing Company is an illustrated descriptive price list of Union stamped steel switch boxes, outlet boxes and covers.

Bulletin No. 1113 from the Fort Wayne Electric Works illustrates and describes their Type M. L. Three-Bearing Belted D. C. Generators with balance wheel for small plants operated by gas engines.

The subject of lubrication is treated in a pamphlet stating the advantages of a pure mineral grease for general lubrication, issued by the Keystone Lubricating Company, Philadelphia.

"Tests of Friction Clutches for Power Transmission," by Prof. R. G. Dukes, a reprint of a paper presented before the last annual meeting of the American Society of Mechanical Engineers, has been issued by the Hill Clutch Company of Cleveland, Ohio.

NEWS OF THE STATIONARY ENGINEERS.

The National Association of Stationary Engineers will hold its sixth annual State convention in San Francisco in June. The committee is made up of members of both of the San Francisco associations, No. 1 and No. 3, including Chairman P. L. Ennor, Secretary A. C. Arbuckle, Treasurer Charles Dick, William Jenkins, James E. Green, John Traynor, H. Noethig, M. W. Herzog, John W. Carter, B. E. George, H. Davis and D. E. Brewer. In addition to the usual papers and meetings arrangements are being made for an exhibit of power machinery at the Auditorium during the week beginning June 14th. Much of the floor space for the exhibits has been already taken by manufacturers and dealers in engineering supplies. The seven subordinate associations in California are working to make this the most successful yet held.

Subordinate Association No. 3, of which W. P. Milner is president and David Thomas secretary, have arranged for a number of talks and lectures on a wide variety of subjects of interest to the engineering and electrical fraternity, of which due notice will be given in the Journal of Electricity, Power and Gas.

The Steam Turbine was the subject of two talks recently given by Mr. W. J. Davis of the San Francisco office of the General Electric Company. On March 24th, at 8:30 p. m., a representative of the Westinghouse Electric and Manufacturing Company will speak on the Parsons turbine at the association rooms in the Merchants' Exchange Building. All those interested in this subject are cordially invited to attend.

DAVID THOMAS, Cor. Sec.

TRADE NOTES.

The Telephone Electric Equipment Company have removed their general offices, sales rooms and warehouse to 612 Howard street, San Francisco.

LOS ANGELES SECTION, A. I. E. E.

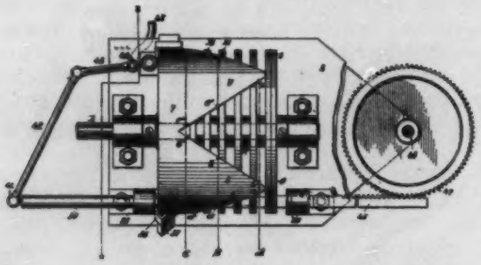
The Los Angeles Section of the American Institute of Electrical Engineers met at the University of California, March 16th. Mr. Clem A. Copeland read an interesting paper on "Transformer Kinks and Wrinkles."

EXAMINATION FOR WIRELESS EXPERT.

The United States Civil Service Commission announces an examination on April 21, 1909, to secure eligibles from which to make certification to fill a vacancy in the position of assistant electrical engineer, expert in wireless telegraphy, in the Signal Service at Large, at a salary of $1,500 to $1,800 per annum, depending upon the experience and qualifications of the appointee, and vacancies requiring similar qualifications as they may occur in any branch of the service. The person appointed to the position for which this examination is held will probably be located for the major portion of his time in Washington, D. C., but he will also be required to travel about the United States visiting wireless telegraph stations, which visits may be of a few days or several months' duration. This examination will consist of theoretical and practical questions in electrical engineering, with special attention to wireless telegraphy and telephony; technical training and experience in the line of the required duties (rated on application). Applicants must indicate in their applications that they have a good general knowledge of electrical science and that they are thoroughly familiar with wireless telegraphy and telephony both in theory and operation. Applicants whose applications fail to show that they have had sufficient training and experience to entitle them to a rating of at least 70 per cent in that subject will not be admitted to the examination.

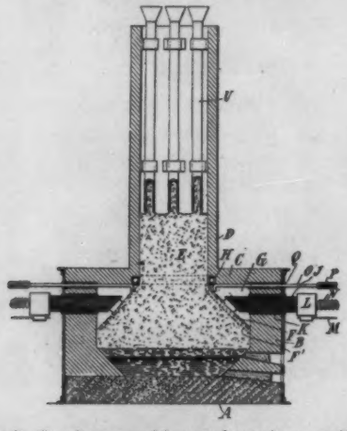
PATENTS

913,753. Light-Regulator for Electric Lamps. Thomas E. Murray, New York, N. Y. The combination of a rotary shaft, a plurality of disks of non-conducting material on said shaft, a plurality of tapered plates of conducting material seated in the



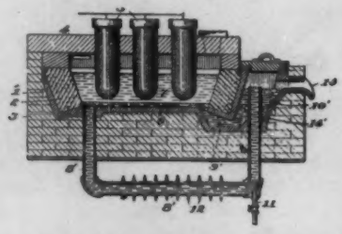
circumferential peripheries of said disks, and a contact bearing on said plates and disks and movable in the axial direction of said shaft.

913,888. Electric Furnace. Paul L. T. Heroult, La Praz, France, assignor to Societe Electro-Metallurgique Francaise, Froges, Isere, France. An electric furnace having side walls B for maintaining a column of the charge, an overhanging



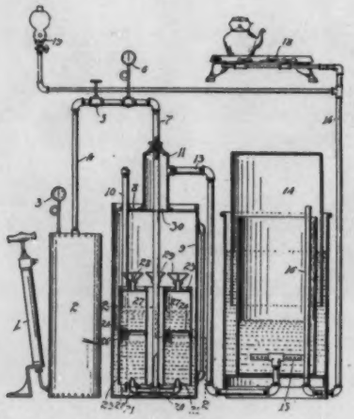
wall C, a shaft D above said overhanging wall and through which the charge is fed, and an electrode beneath said overhanging wall, said parts being proportioned and located to permit the removal of the electrode out of contact with the charge.

914,214. Electrolytic Process of Producing Nitrogen Compounds. Charles E. Acker, Niagara Falls, N. Y. The electrolytic process of producing nitrogen compounds, which consists in continuously electrolyzing a molten compound of a



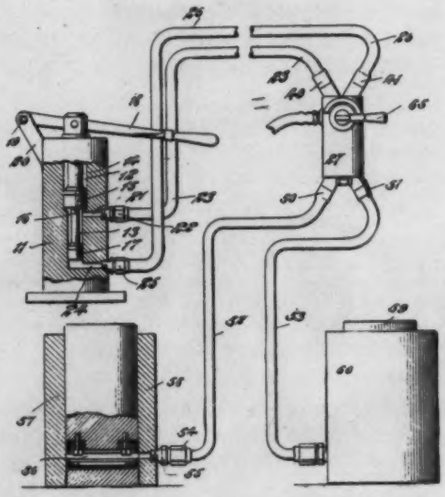
metal capable of forming nitrogen compounds, alloying the separated metal with the cathode metal, removing the alloy and reacting on it with a nitrogeneous reagent, separating the products of reaction, and returning the residual metal to the cathode.

913,733. Gas-Generator. James A. Kenworthy, Oakland, Cal. A carbureter comprising a casing adapted to contain volatile oil, a plurality of receptacles therein open at the bottom to the entrance of the oil, a pipe extending to the bottom of the casing, conduits leading from the bottom of said pipe, one for each receptacle, and discharging upwardly



into the open bottom of said receptacle, contracted outlets at the tops of the receptacles, screens arranged horizontally above said outlets, against which the air emerging from the receptacles impinges, a discharge conduit for the gas, and a screen covering the bottom of the discharge conduit, substantially as described.

914,165. Device for Controlling Hydraulic Pressure. James W. Nelson, New York, N. Y. In combination, a plurality of means having the common operative means for generating hydraulic pressures, means apart therefrom for combining



said pressures or rendering effective one thereof only and for controlling and distributing the resultant pressure, and means for simultaneously applying said resultant pressure at a plurality of selective points.

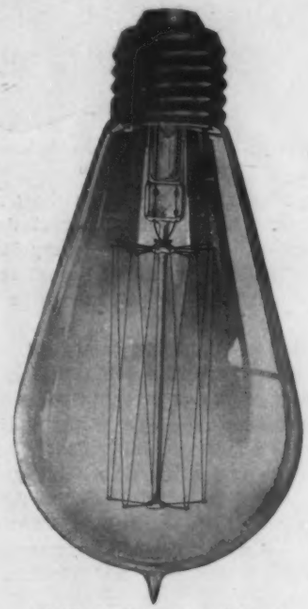
INDUSTRIAL

A NEW SMALL-BULB 40-WATT TUNGSTEN LAMP.

Several months ago a 25-watt Tungsten lamp was placed on the market with a bulb practically the same as used in the familiar 16-candle-power carbon lamp and which could be used as a substitute for the carbon lamp in any fixture or shade. This lamp came into immediate favor and general use, but it lacked one of the chief advantages of the use of Tungsten filament lamps—a large increase of illumination without increasing the current consumption.

The General Electric Company has recently placed on the market a small bulb lamp with a 40-watt Tungsten filament giving double the candle power of the present 16-candle-power carbon lamps, but taking only four-fifths of the current. This lamp, when substituted for the carbon lamp, will therefore not only materially reduce the cost to the customer, but will greatly increase the standard of illumination by doubling the quantity and bettering the quality of the light given.

As seen by the accompanying illustration, which shows the lamp in about two-thirds size, the bulb and base are



40-Watt Tungsten Lamp.

practically the same as that of the ordinary incandescent carbon lamp.

This new 40-watt lamp contains all of the many improvements in filament construction and methods of support perfected by the General Electric Company, and truly represents the latest and best development in Tungsten lamp manufacturing. Like other General Electric Tungsten lamps, it can be burned in any position without affecting its life or candle power, and its small bulb adapts it to all ordinary shades, chandeliers and brackets.

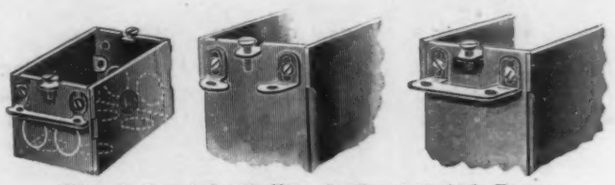
Its price is less than that of the regular large-bulb Tungsten lamp with shoulder base, and the operating cost, including cost of lamp and current, is less than any incandescent lamp smaller than the 60-watt Tungsten. Furthermore, the customer is not required to include in the purchase of the lamp a new outfit of special fixtures, shades, etc. From a commercial standpoint, therefore, it is the easiest selling lamp on the market and is of additional value to the central station in maintaining the revenue from its customers.

The new small-bulb 40-watt lamp can be used in installations now using the old type with shoulder base and Holophane reflectors by changing the shade holder from the "H" type to the "O" type. This will raise the reflector around the lamp so as to bring the filament in correct "focus" and obtain practically the same efficient distribution of light from the reflecting and refracting prismatic surfaces.

"UNION" SHALLOW SECTIONAL SWITCH BOXES.

To accommodate the growing demand for shallow switches and receptacles that has lately induced the makers of this line of goods to bring out a shallow type switch, the Chicago Fuse Wire and Manufacturing Company has designed two shallow boxes of the sectional type construction, to be employed in thin partitions, outside walls, and where there is not ample room, or where it would entail additional work in cutting away the material, to install a deeper box.

The "CCS" or loom box as shown in single in Fig. 1 is two inches deep, outside dimensions, and will take all makes



Figs. 1, 2 and 3—Shallow Sectional Switch Boxes.

of shallow switches and receptacles. The switch lugs are drilled on standard centers, and being formed outward, enable the body of the box to be made short enough so that the attachment ears are effectually covered by the flush plate when used in old work.

The "CCS" box is provided with two knock-outs in each end, but has none in the back. It may be equipped with any of the three types of ears shown in Figs. 2, 3 and 4.

It may be built up into gangs from the single box, as well as from the 2-gang, and the hook-eye construction being used throughout allows the spacers to be inserted without removing screws, which avoids the danger of their being lost in the operation.

Fig. 2 illustrates the regular type "F" ear, which is always furnished on "union" switch boxes, unless one of the

Figs. 4 and 5—Shallow Sectional Switch Boxes.

other types is desired; has the well-known sliding adjustment and reversible feature so that it may be set to various depths when used in new work, according to the thickness of the plaster, and being supported by pivoted connection, they may be turned at any angle to enable striking of the lath, which is particularly convenient in old house wiring.

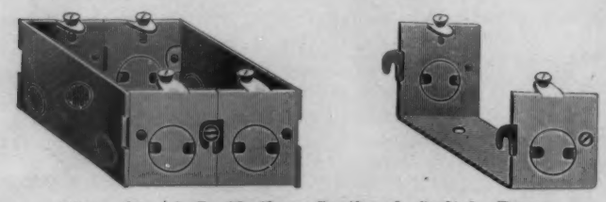
Fig. 3 shows type "C" ear, which for certain places is desirable, especially when used in connection with a rotary flush switch in which the plate has no supporting screws, the ears, being recessed into the plate, help hold it more rigidly in place.

Fig. 4 shows the type "SF" ear, which is used only in connection with new work, is often preferred where a strong

anchorage of switch box is desired; the attachment screws being farther from the edge of the supporting strips, are less likely to split or pull out.

This ear is also provided with an adjustment slot, so that the face of the box may be brought out three-quarters of an inch to seven-eighths of an inch from the plaster line, and being of stamped steel, there is no danger of them breaking off by falling or by being twisted at an angle, as frequently occurs in the case of cast-iron switch frames.

In Figs. 5 and 6 the No. 170, or shallow conduit box, is shown in single and 2-gang, while Fig. 7 shows the spacer used to build the box up into any number of gangs. This wall case measures four inches long, two inches wide and seven-eighths of an inch deep, outside dimensions, and has switch lugs spaced to take all makes of standard shallow switches and receptacles. As shown in cut, this is a combination loom and conduit box having entrance at each end for one-half-inch conduit or "BX" armored cable, and two



Figs. 6 and 7—Shallow Sectional Switch Boxes.

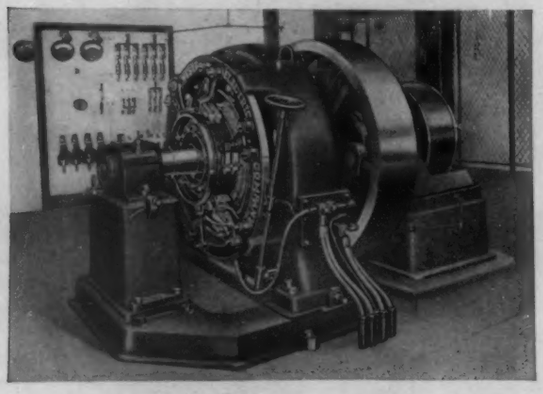
five-eighths-inch openings on either side for loom, these being located as far from the center as possible so that the ends of the tubing will not interfere with installation of the switch.

The box, being one and seven-eighths inches deep, particularly lends itself to use in outside walls where a one-inch ferring strip is used on the brick and a one-quarter-inch lath, leaving five-eighths of an inch for plaster, in which case the conduit can be run back of the lath, and it is not necessary to recess the box in the brick wall. This box is also equally suitable where thin partions are constructed with one-inch uprights for holding of the lath. The combination of conduit and loom outlets in the same box makes it particularly adapted to use where changes are made from conduit or open work.

A flat steel cover can be furnished for this box, which makes it an excellent small junction or pull box, and when desired in new work it can be equipped with either of the ears noted above at a price corresponding to the "CCS" box.

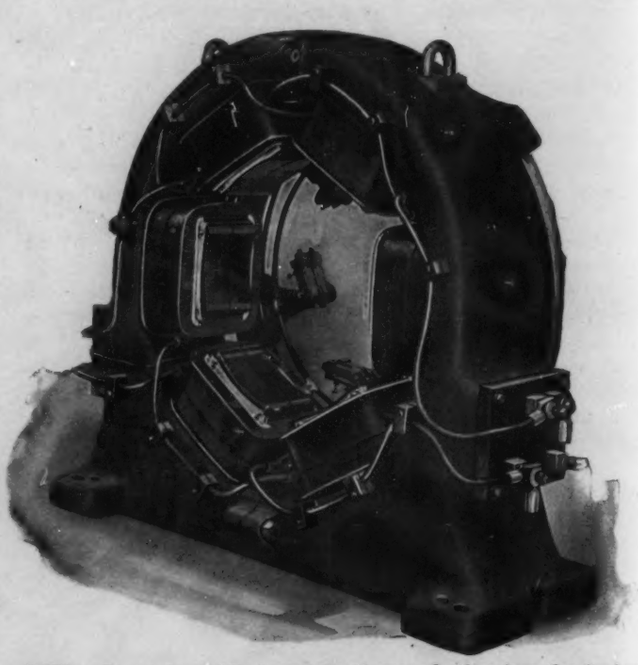
THREE WIRE GENERATORS.

Of the many new features embodied in the design of three wire D. C. generators recently put on the market by the



75 k. w. 3-Wire Generator Installed in the Plaza Hotel, Chicago.

Western Electric Company, the most distinct is a doubly wound armature which is employed for obtaining the neutral e. m. f. point. The coils of this balancing winding lie beneath the usual armature winding and at the bottom of the slot, which is made deeper for this purpose. This winding is interconnected with the main armature winding and with a slip ring in such a way that the slip ring always possesses a potential midway between the potentials of the two



3-Wire Generator with Armature Removed, Showing the Series Field Connection.

brushes. The section of the copper in the auxiliary winding is very liberal, thus keeping the current density low and enabling the machine to take care of very large unbalanced loads without injury to any part. The voltage regulation is close even under sudden or large changes in the unbalanced loads.

In order to compound for the total load on the generator under all conditions, the series field winding is divided into two parts, one-half of the coils being connected to one terminal of the armature and the other half to the other terminal; the coils on alternating poles being connected to the same side of the armature. The liability of the breaking down of the insulation is reduced to a minimum since coils having the full potential of the machine between them are not placed on the same pole. This arrangement further results in perfectly balanced magnetic and electric circuits. The neutral wire is connected to the brushes, which rest on the collector rings, electrically insulated from, but mounted at the end of the commutator. This simple construction is possible because no shifting of the neutral brushes is required no matter what amount of overload is carried.

During the process of manufacture, all parts are subjected to rigid inspection, and tests, and the completed machines are tested under load for a sufficient length of time to assure that they come within the guaranteed limits of heating and sparkless operation. The insulation of the various parts of the machine and the completed machine are tested by the application of high voltage.

CUTLER-HAMMER CO. OPENS CLEVELAND OFFICE.

The Cutler-Hammer Manufacturing Company of Milwaukee, makers of electric controlling devices, announce the opening of a District Office in Cleveland, Ohio—1108 Schofield Building. The new office will be in charge of Mr. C. J. Kruse, who comes from the Engineering Department of the Cutler-Hammer Company and who is well qualified to advise regarding the proper device to use in any case involving the control of electric motors.

SOME RECENT TANGENTIAL AND TURBINE WATER WHEEL PRACTICE.

BY GEORGE J. HENRY.

The work by the principal manufacturers in this field in recent years has been marked by some radical improvements both in the design and adaptation of tangential water wheels for operating under comparatively high pressure, and also in turbines for handling larger volumes of water under low pressures.

The development of power, especially on the Pacific Coast, has been tending towards the operation of larger units under lower pressures and of course requiring correspondingly increased volumes of water. This tendency is attributable to

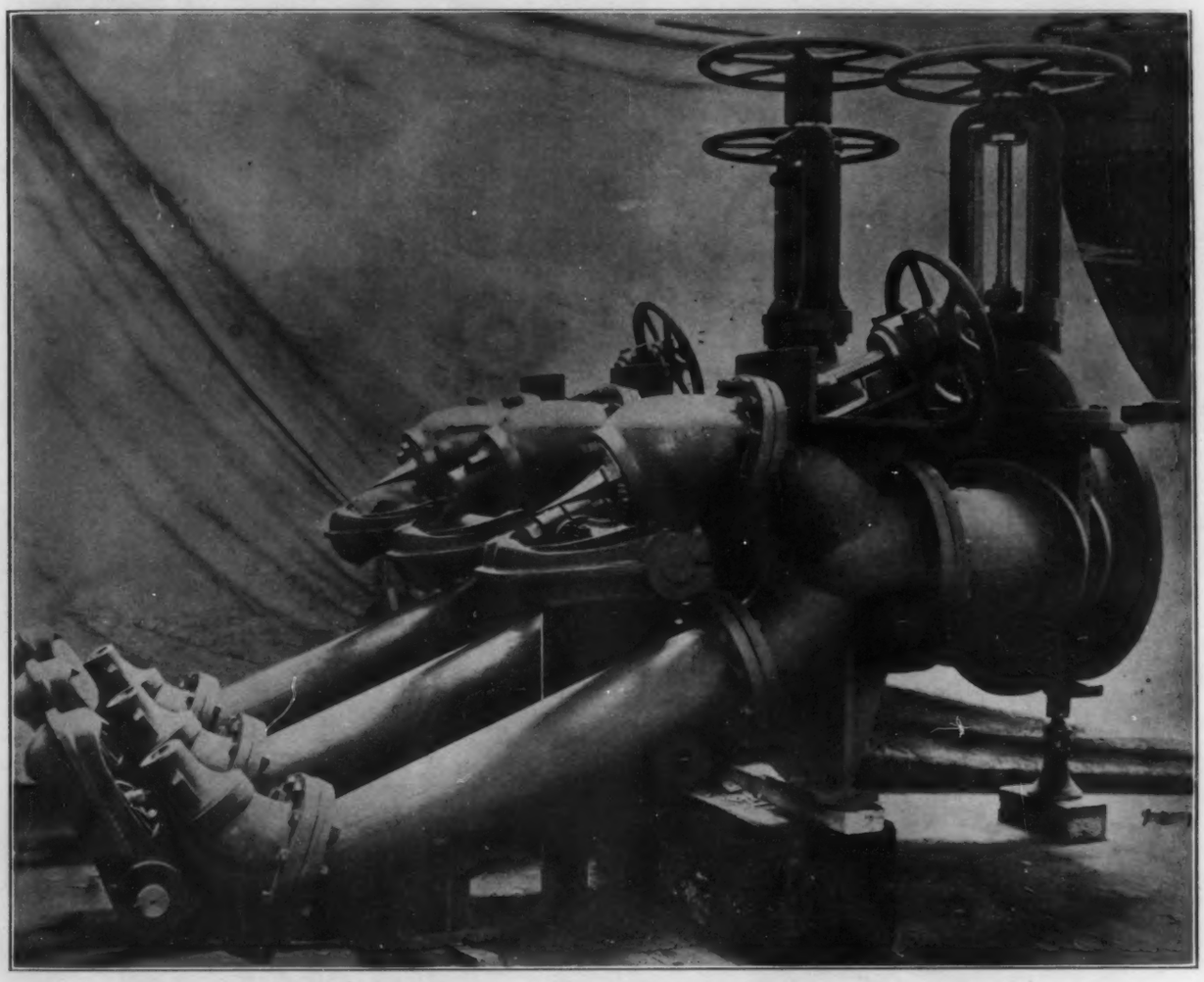


Fig. 2. Triple Double Nozzle for Impulse Unit, Equipped With Counterbalanced Stream Deflectors for Hand-Controlled Needles.

several causes—among others being the fact that the less expensive high pressure power sites sufficiently close to the power markets have been largely taken up, and it therefore became necessary to go further into the mountains, making a very high and uncertain cost or using the rivers at a lower point on the mountain slopes, where the fall is seldom as great. The phenomenal growth of this commercial development in the Western States has also made the market much more secure for investors in this industry, and the manufacturers' practice has become sufficiently crystallized and assured to further accentuate this point.

Indeed, manufacturers have also been putting forth great effort in this line and the reliability of hydraulic power-house apparatus is becoming more and more assured. On the other hand, water power development has been handicapped to a considerable extent on account of the uncertain financial conditions throughout the country during the past several years, creating an uncertain and low bond market which discouraged the promotion of new enterprises such as these, which depend almost entirely upon bond issues. It is, of course, hoped that a brightening of the financial outlook during the coming year will result in a considerable impetus to this industrial development.

From the manufacturer's standpoint, there is constantly a strong tendency imposed by the purchasers of water wheel apparatus to cheapen the product; the average purchaser of water wheels has not had sufficient experience with this class of machinery to readily understand the necessity for the highest grade of construction, and in fact considers this of secondary importance only, when compared with the first cost, as it influences the success of his enterprise. In fact, the few dollars more or less per horsepower expended on the water wheel equipment, makes but a very slight difference in the total cost per unit of power of the plant, and goes a long way to insure the most successful operating conditions and therefore the most permanent and safest investment, bringing in assured and satisfactory returns.

From the standpoint of machine design, it is of course advisable to simplify the mechanical features to the maximum point. On the other hand, there are probably more variables entering into the design of water wheel apparatus where it is properly adapted to meet the individual conditions in any particular plant, than in any other class of machinery; and for this reason it is impossible for a conscientious manufacturer to attempt to standardize water wheel units to any extent. Some of the individual parts, such as gate valves, bearings, etc., can

to a certain extent be standardized; but in order to use them in a rigid and built-up structure forming a "prime mover" unit, involves in every instance expensive pattern changes and development charges; and in order that the manufacturer may be properly prepared to duplicate any parts of the apparatus in the event of their becoming worn or damaged in operation, lost in transportation, etc., it is highly advisable that complete jigs and templets of at least all the important parts be retained. This is, of course, a very expensive item, which it is hard to convince the average purchaser is a good investment. The writer believes it will be found to have been the experience of most water wheel manufacturers that it is always easier to demonstrate the monetary value in hydraulic apparatus to a purchaser who has had considerable previous experience—the more the better—and that such a purchaser does not hesitate at any expense which secures for him simplicity, interchangeability, rigidity and the introduction of any and all devices that make absolutely continuous and efficient operation most certain. In negotiating the sale of such apparatus to a purchaser unfamiliar with it (as is very frequently the case where promoters or financial agents carry on the negotiations), a campaign of education along the above line is almost essential.

The value of water is becoming more and more important in almost all power plants; and in the case of tangential water wheels any control of the water flow in high pressure and unusually long pipe lines involves the very serious question of water ram—one of the most dangerous factors to contend with in power house design. The use of the stream deflector operated

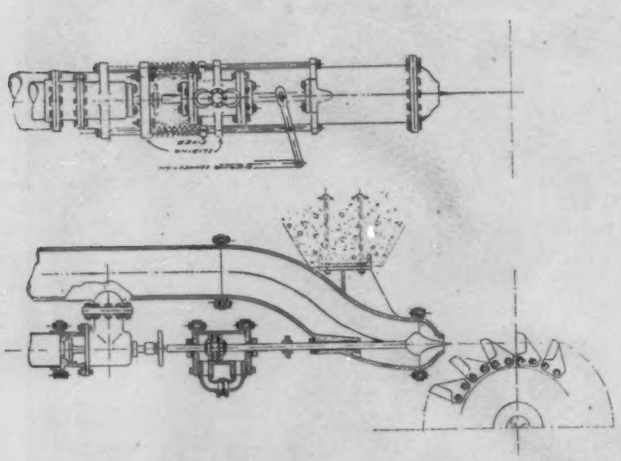


Fig. 1. Pelton By-Pass Nozzle.

by an automatic governor and the hand control of regulating needle valves to a very considerable extent serves the purpose of economizing the water that would otherwise go to waste during those hours of the day or year when the plant is operating below a maximum capacity. On the other hand, however, while such apparatus may be built for water economy, depending on the attention of the power house operators, such attention is not always given, and in many instances the manufacturers and engineers of power plants are not particular to instruct the operators regarding this important feature. The writer has frequently seen such nozzles wasting water from a storage reservoir which would be worth considerable before the season is over; whereas a little attention on the part of the operator in adjusting the needle to the daily or hourly requirements would save water in the reservoir, enabling the power company to furnish a much better peak load during the very dry months.

The use of the by-pass nozzle (see article by the writer in Transactions of the American Society of Mechanical Engineers, May, 1906, also U. S. Patent 853786) to a considerable extent overcomes this defect and makes the water saving automatic. Such a nozzle renders the tangential water wheel the equivalent of a turbine regulated by wicket gates, and having a slow-closing by-pass valve rigidly connected to the gate ring and the governing mechanism.

Fig. 1 illustrates this nozzle. The simplicity of its design, the few connecting parts and the impossibility of dangerous water ram occuring, make this form of nozzle a decided step in advance of the combination stream deflector and needle nozzle. On account of the constant demand for larger power units, the use of the deflecting nozzle is rapidly giving place to the counterbalanced stream deflector, which is a very much lighter device and one entirely independent of water pressure, except to a slight extent when it is operating within the stream range. The load on the governing mechanism for operating such a deflector is therefore very much less, enabling lighter and cheaper governors to be used. The great reduction in the inertia of the moving parts enables the control, with an equal governor effort, to be much quicker and the regulation correspondingly more sensitive and accurate.

Fig. 2 shows a triple double nozzle for an impulse unit equipped with patented counterbalanced stream deflectors and hand controlled needles. These Pelton counterbalanced stream deflectors have been used on all sizes of units up to 5000 k. w. output and under operating pressures in excess of 1900 feet with the highest degree of success; and in cases where more than one

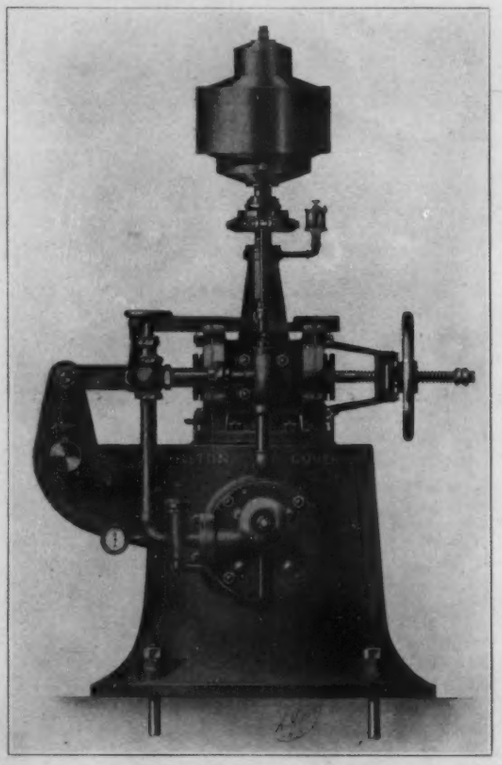


Fig. 3. Modern Pelton Governor.

nozzle is used on a wheel are the only means of satisfactorily controlling the speed without water ram.

Great strides have also been made in governing apparatus. The modern Pelton governors (Fig. 3) are characterized by a highly sensitive centrifugal element having a very large moving effort for an extremely slight speed change. The governor shown in the illustration puts forth in excess of 20 pounds for shifting the valves controlling the oil pressure flow to the operating cylinders on a speed change of 1%. Such effort shifts a pilot valve, the motion of which is instantaneously followed by a secondary valve of much larger port areas, enabling a complete stroke of the governor cylinder in 1½ seconds. The governor is equipped with independent hand control and electric control from the switchboard, with patented automatic safety lever, causing a closing down of the plant in the event of the governor belt running off or being broken. It is also provided with adjustable relay and returning devices, and is about as simple and efficient

in its operation as a governor can be constructed. Its design has been carried out exclusively for the control of Pelton tangential wheels and Pelton-Francis turbines; and it is provided with self-contained oil pumps, unloading valves and all connections; the entire governor apparatus being complete in one machine, thus avoiding the necessity for skilled labor to secure its proper installation, as also the usual complicated network of

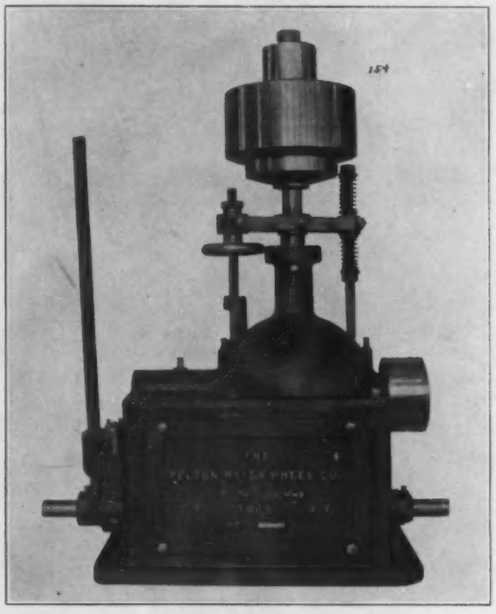


Fig. 4. Pelton Mechanical Governor.

pipes. It has no vacuum system, using oil under pressure only, thereby eliminating one of the most frequent causes of governor trouble in the earlier power houses. The governor is made in several sizes up to 25,000 feet pounds capacity and the same principles of design are also carried out in a mechanical governor, as shown in Fig. 4, which contains no oil system, and of course is suitable only for controlling comparatively small units.

A brief description of a few of the more recent installations and some of the special features involved therein will probably be of interest.

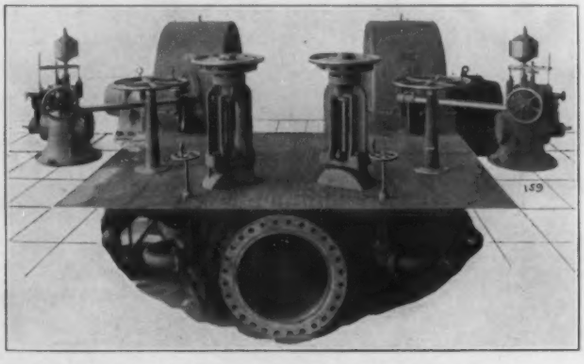


Fig. 5. Plant of Northern Light and Power Company.

The plant of the Northern Light and Power Company is illustrated in Fig. 5. This consists of two 1500 h. p. Pelton units each driving a 750 k. w. generator at 450 rpm., the wheels operating under an effective head of 680 feet. Each unit is controlled by a Pelton oil pressure governor and deflecting nozzle. In this case, water storage is not available, and hence regulation is accomplished exclusively by deflecting the stream.

Fig. 6 (photo page 179, issue of JOURNAL March 6, 1909) illustrates a water wheel recently constructed by the Pelton Water Wheel Company (after designs by Mr. W. R. Eckart) for driving a 5000 k. w. unit at the Electra plant of the Pacific Gas and Electric Corporation. This wheel develops the full capacity with a single jet of water, operating under about 1400 feet head. The method of attaching the buckets is unique. The wheel center is of nickel steel (in two pieces) and the

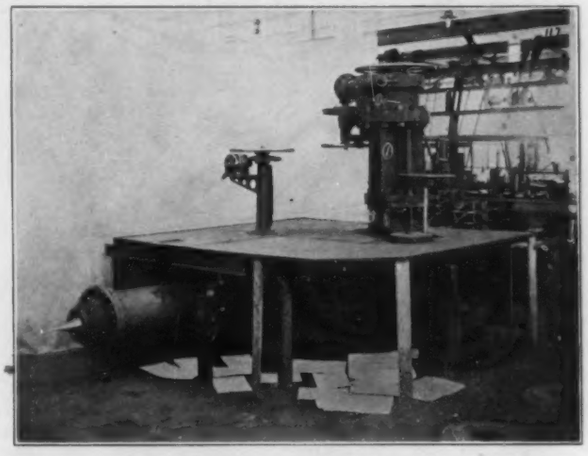


Fig. 7. Arrangement of Nozzle, Gate and Floor Plate for Stanislaus Power Company.

buckets are attached with two nickel steel bolts each driven in reamed holes. This wheel replaces one of other manufacture.

Fig. 7 shows the arrangements of the nozzle, gate and floor plates for one-half of one of the units of the Stanislaus Power Company, whose 36,000 h. p. plant on the Stanislaus River has been in operation with the highest degree of success for a number of months past. In this case, the position of the needle valve is controlled electrically from the switchboard. The gate valve is of the outside screw and yoke, bronze mounted, single disc Pelton type, with oil packed roller thrust bearings; and has both quick and slow motion hand control, cast steel by-pass and water motor control for operating in either direction with automatic cut-outs. The wheel units in this case are of the well known

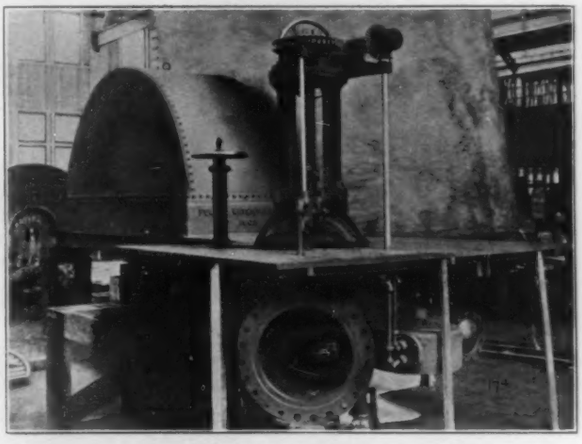


Fig. 8. High Pressure Cast Steel Pelton Gate Valve.

Pelton overhung construction, i. e., one water wheel mounted on each end of a single shaft with an engine type 6750 k. w. General Electric generator mounted between the bearings. The plant has been thoroughly tested out and the wheels give both efficiency and overload in excess of the guarantees. These are the largest tangential water wheel units in the world, each unit having developed in excess of 15,000 h. p. The automatic control is effected through deflecting nozzles operated by special Pelton

oil pressure governors with switchboard control, safety levers, self-contained oil pumps and unloading valves.

The exciters are of the single overhung type with Pelton governors and induction motors.

Fig. 8 shows a high pressure cast steel Pelton gate valve with all pressure parts mounted below the floor and hand and reversible water motor control and automatic cut-out.

Fig. 9 shows a complete iron-mounted type of Pelton unit, well adapted to the requirements of the average mining plant.

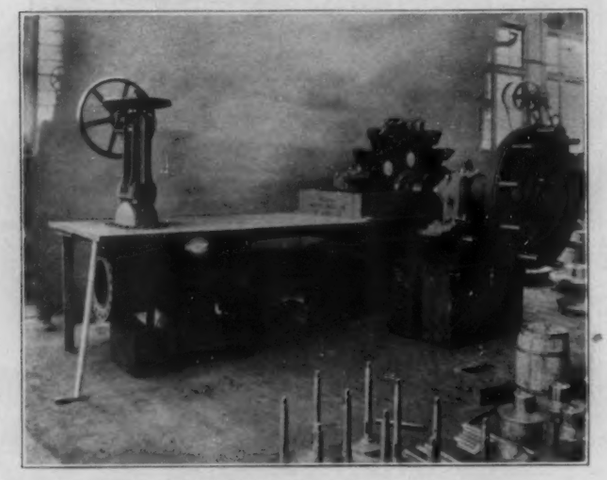


Fig. 9. Pelton Unit Adapted to Mining Plant.

This equipment was constructed for the Hazel Gold Mining Company of Trinity County for operating under an effective head of 680 feet and for direct connection through a flexible leather link coupling (one-half of which is shown in the cut) and solidity. The wheel centers and buckets are of cast steel and the bearings are of the Pelton generator type.

As regards some of the characteristic features of Pelton-Francis turbines, attention is directed to Fig. 10. This shows controlled by an automatic Pelton governor (not shown in the

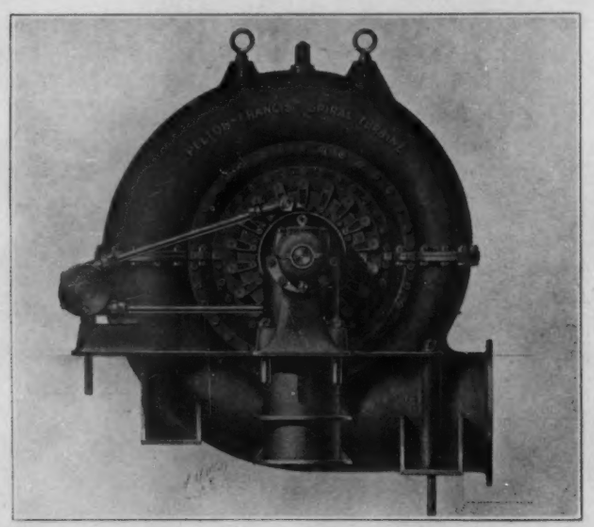


Fig. 10. Outside Wicket Gate, Controlling Ring and Wrist Plate Connections to Pelton Governor.

cut) and the entire construction is characterized by simplicity to a 550 k. w. 450 rpm. generator. The deflecting nozzle is the outside wicket gate, controlling ring and wrist plate connections to the Pelton governor, also the rigidly connected by-pass valve operating below the floor line, the generator type bearings, geared gate valve, pressure and vacuum gages and spiral case. Fig. 11 shows these governor connections and by-pass valve, together with the slow returning oil dashpot, effecting water economy without water ram in the pipe line.

Four 5000 h. p. vertical type Pelton-Francis turbines running at 300 rpm. under an effective head of 147 feet have been in operation for some time at the plant of the Schenectady Power Company, transmitting power to the General Electric Company's works at Schenectady, N. Y. These are mounted on the vertical shaft of the generator, which is extended below the floor line,

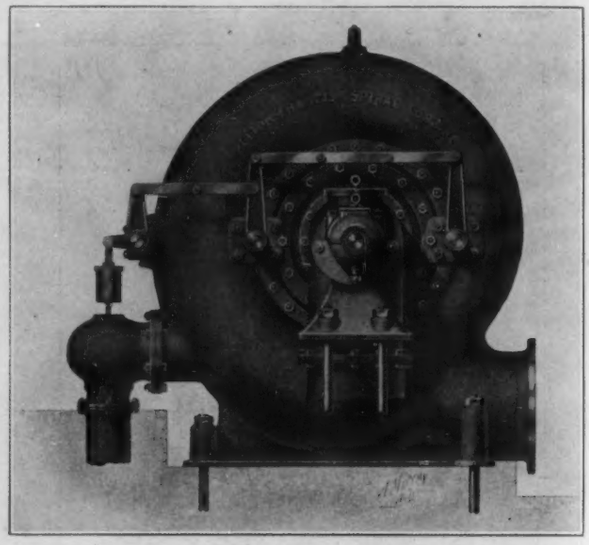


Fig. 11. Governor Connections and By-Pass Valve.

bringing all of the water pressure pipes and connections beneath the floor. The weight is carried by roller bearings running in oil, and the bearings are relieved of about 75 per cent of the weight of the rotating element by the design of the turbine runner, so as to make use of the reaction.

In the same plant there are 250 h. p. horizontal shaft Pelton-Francis turbines driving the exciters at 600 rpm.

At the plant of the Claremont Power Company, Cavendish, Vt., there are three 750 h. p. 600 rpm. double horizontal shaft

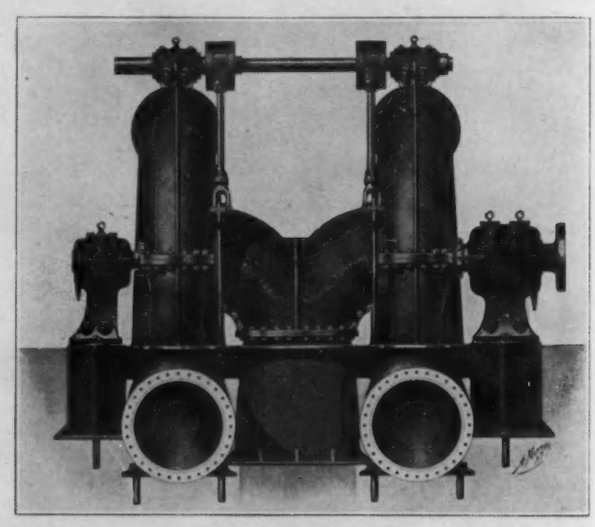


Fig. 12. Pelton Francis Spiral Turbine.

Pelton-Francis turbines, operating under an effective head of 120 feet.

At the plant of the Black Hills Traction Company, near Spearfish, So. Dak., there are two 1100 h. p. 400 rpm. horizontal shaft, double Pelton-Francis turbines, operating under a head of 110 feet.

The Pelton-Francis type of turbine is characterized by its high efficiency, which has, in numerous cases, exceeded 85 per cent.

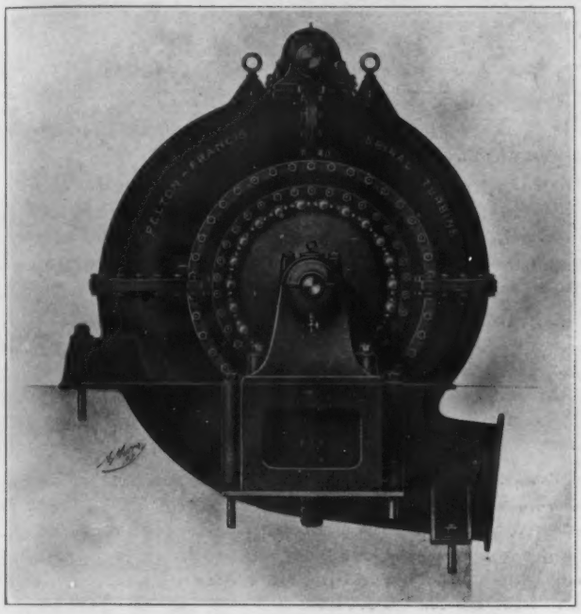


Fig. 13. End View of Pelton Francis Spiral Turbine.

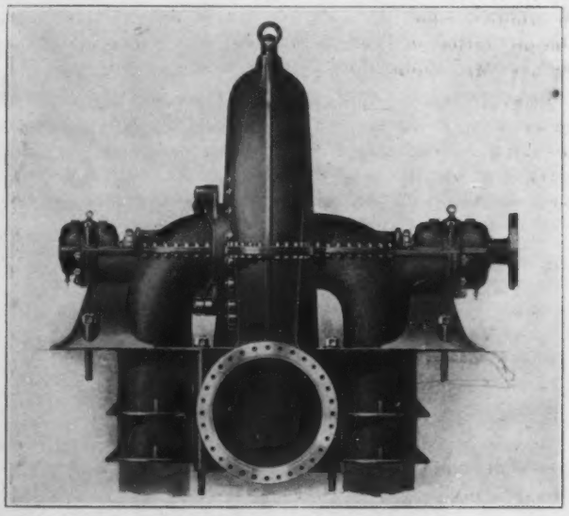


Fig. 14. Turbine for Utah Light and Railway Company.

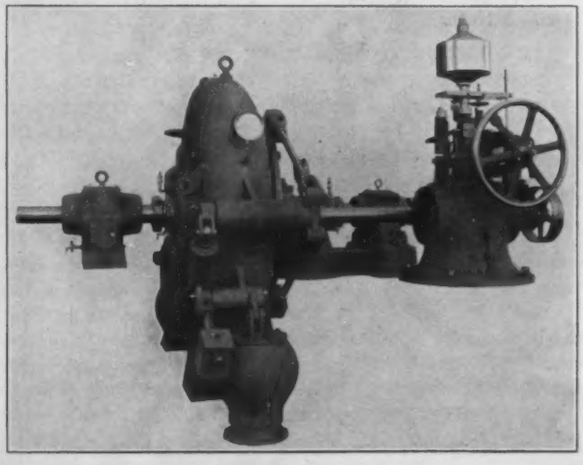


Fig. 15. End View of Turbine for Utah Light and Railway Company.

Fig. 12 shows the type of turbine of which two are now being constructed, of 1200 h. p. capacity each, under an effective head of 45 feet and direct connected to 300 rpm. generators. This illustrates the rigidity of the governor connections, the generator type bearings and the smooth curvature given to all of the water channels. An end view of the same turbines is shown in Fig. 13, which illustrates more clearly the spiral case and the method of bolting together the various parts so as to enable the turbine to be readily dissected, every heavy piece, including the runner, being easily handled by the crane.

Fig. 14 illustrates the form of turbine now under course of construction for the Utah Light and Railway Company for their Devil's Gate plant, having a capacity of 5000 h. p. at a speed of 360 rpm. and for operating under an effective head of 142 feet.

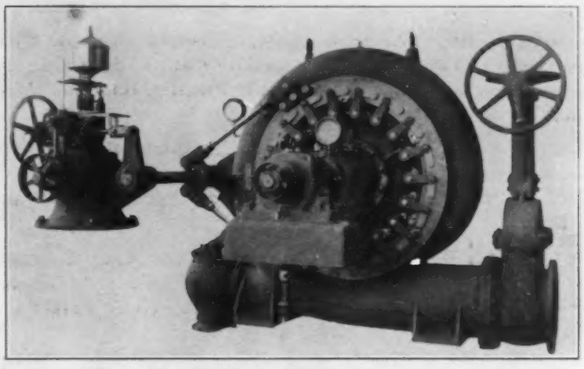


Fig. 16. End View of Turbine for Utah Light and Railway Company.

Fig. 15 shows one end view of this turbine with the water relief valve with slow returning oil packed dashpot; and Fig. 16 shows a view of the other end of this unit with the governor wrist plate, external gate operating connections, etc.

In addition, there are now also under course of construction two 4000 k. w. water wheel units, one 2000 k. w. and two 1000 k. w. units of the Pelton tangential type.

MACHINERY HAULAGE

The accompanying illustration shows a thirty-ton condenser for the City Electric Company, San Francisco, which required twenty-four horses to haul from the freight sheds to the company's plant at the foot of Mason street. This

work was done by the Jones Draying Company. The work of delivering heavy machinery to power plants requires great care, as the apparatus is often put on the foundation by the haulers. Many large power plants are built directly on the line of railroads, but in large cities this is often impossible, reliance being placed upon teams.

NEWS NOTES

INCORPORATIONS.

BAKERSFIELD, CAL.—The La Blanc Oil Company has been incorporated here with a capital stock of $250,000 by John La Blanc and others.

RIVERSIDE, CAL.—The Tahoe Park Land & Water Company has been incorporated here with a capital stock of $24,800 by W. J. G. Lambert, E. L. Lambert and G. E. Dole.

RIVERSIDE, CAL.—The Coral Reef Land & Water Company has been incorporated here with a capital stock of $10,000 by C. L. Hall, E. H. Kellar, W. T. Kendrick and J. W. Utter.

RIVERSIDE, CAL.—The Corona Pumping Company has been incorporated here with a capital stock of $25,000 by M. L. Coleman, J. Adams, A. O. Hall, Priestly Hall and J. B. Knight.

SAN FRANCISCO, CAL.—The Tri-County Oil Company has been incorporated here with a capital stock of $5,000,000 by H. G. Platt, D. M. Burns, J. J. Moore, A. D. Shephard and R. Bayne.

OAKLAND, CAL.—The Associated Pipe Line Company has been incorporated here with a capital stock of $7,000,000 by E. E. Calvin, G. L. King, W. F. Herrin, W. S. Porter and F. H. Buck.

FRESNO, CAL.—The Section Thirty Oil Company has been incorporated here with a capital stock of $200,000 by W. L. Evans, of Lancaster, Pa.; G. W. Strominger, of Berkeley; A. D. Windsor, T. C. Gray and Paul Kocheb, of San Francisco.

BERKELEY, CAL.—The Sierra Electric Power Company has been incorporated with a capital stock of $500,000 by F. E. Horton, Benjamin F. Woolner, T. C. Warren and Boyd L. Wilson. Water rights have been secured on Battle Creek, Tehama county, and a power plant costing $500,000 is being constructed there. Attorney Greer, representing the company, has applied to the Supervisors of Butte county for a franchise to erect power lines in that county, and April 6th has been set by the Supervisors as the date of sale.

TRANSMISSION.

GLENDALE, CAL.—The City Council has passed a resolution for the construction of a municipal electric light and power plant in this city.

QUINCY, CAL.—The Round Valley Water Company was granted a franchise this week to construct power lines along the highways in Indian township.

RED BLUFF, CAL.—Secretary F. C. Wilson, of the Sierra Electric Power Company, has asked for a franchisee to construct electric power lines in Tehema County.

BAKERSFIELD, CAL.—The Kern Power, Transit & Light Company has begun rebuilding its power line from this city to the power station in the Kern River Canyon.

INDEPENDENCE, CAL.—Henry Rainey, representing the J. Levering Jones and Reward & Brown companies, visited this city last week for the purpose of finding desirable property for building a power plant.

CHICO, CAL.—As a result of the application of Frank C. Wilson, representing the Sierra Electric Power Company, bids will be received by the City Council till April 2, 1909, for the sale of a fifty-year franchise for the transmission of power in this city.

SAN FRANCISCO, CAL.—Word has reached this city from Parral, Mexico, that President G. F. Greenwood, of the Mexican Northern Electric Company, is now in that city securing a site on the Conchas river, near Parral, for the erection of a $5,000,000 electric power plant.

HORNBROOK, CAL.—The Siskiyou Electric Light & Power Company is now at work on the new power line from Snowden to the mines on the Klamath river. The company plans about April 1st to begin building its power line through Little Shasta Valley to Sisson and Dunsmuir.

GOLDFIELD, NEV.—The Nevada-California Power Company is to begin within a few months to extend its electric power line from Tonopah to Ely, Nev., a distance of 150 miles. By this extension a number of large power consuming plants will be reached which are now manufacturing their own power.

BAKERSFIELD, CAL.—John McWilliams, Henry Martens and others have purchased 8,000 acres along the banks of the Kern river, near the Kern river oil fields, for the purpose of building an electric power plant. By securing this location a great many of the engineering difficulties are overcome, and a fall of over 250 feet is secured.

SAN FRANCISCO, CAL.—Vanderlynn Stowe, receiver for the Tuolumne Water Power Company, and George H. Whipple, receiver for the Stanislaus Electric Company, have been granted orders by Judge de Haven for the maintenance of the properties of these companies. Mr. Stowe was allowed $5,000 and Mr. Whipple $12,000 per month.

VISALIA, CAL.—The suit of the Platt Iron Works, of Los Angeles, against the Mt. Whitney Power Company, to recover $6,907.74 alleged balance due on the purchase of $16,475 worth of machinery for the company's plant on the Kaweah river, in Tulare County, has been transferred from the Superior Court of Los Angeles to the Superior Court of this city.

BODIE, CAL.—Plans are being made for locating two power plants in this vicinity, one on Rush creek, capable of producing 15,000 horsepower, and the other on Leevining creek, capable of producing 15,000 horsepower. A number of owners of mines and mills here have expressed their desire for electric power, and before the coming summer all will be in readiness to supply them.

GRASS VALLEY, CAL.—Chief Engineer Trow, representing the California Midland Railroad Company, is now engaged in making surveys for a twelve-mile ditch which is to carry sufficient water to generate several thousand horsepower at a point on the Yuba river, not far from Smartville. The estimated cost of completing the ditch is $300,000. It is understood that the electric power is to be utilized in operating the company's trains.

SAN FRANCISCO, CAL.—The Great Western Power Company has completed the necessary repairs on the nine miles of its steel cable towers which were blown over by the storms of last January. The power line from Sacramento to Oakland is now complete and power can again be supplied to the Bay cities. The steel towers which were originally imbedded in the earth, are now set in foundations of concrete, so that it will be impossible for the strongest winds to overturn them.

SAN FRANCISCO, CAL.—Attorney Charles P. Eels, represening James K. Moffitt, J. D. Galloway, H. P. Goodman and E. H. Rollins & Sons, bond holders in the Stanislaus Electric Power Company, Stanislaus Electric Railway Company, Tuolumne Water Power Company and the Union Construction Company, was authorized this week to contest the foreclosure of a mortgage held by the Knickerbocker Trust Company, of New York, against these companies. The other defendants have filed answers consenting to the foreclosure of the mortgage and the sale of the properties.

TELEPHONE AND TELEGRAPH.

MADERA, CAL.—Thirty thousand dollars has been subscribed for the proposed gas plant in this city.

AZTEC, N. M.—The Eden Canal, Land & Power Company has begun construction work on its electric light plant in this city.

ONTARIO, CAL.—The City Council has granted a franchise to J. R. Anderson for construction of an electric light and gas distributing system in this city.

BERKELEY, CAL.—The Pacific Telephone & Telegraph Company has about completed a number of improvements in this city which will cost upwards of $75,000.

ELY, NEV.—A new company has been formed here to be known as the Spring Valley Telephone Company. The incorporators are Henry C. Nicholson, Joseph E. Stevens and Eugene Giles. The company proposes to build a telephone line from Muncey to Osceola.

TRANSPORTATION.

GLOBE, ARIZ.—George P. Hunt has been granted a 25-year franchise to build an electric line in this city.

MODESTO, CAL.—The Modesto Empire Traction Company has completed plans for the route of its proposed line.

BERKELEY, CAL.—The new cross-town Dwight Way electric line of the Oakland Traction Company is now in operation.

VALLEJO, CAL.—Manager M. McIntyre, of the Napa Valley Electric Railway Company, is now in this city pressing his claims before the City Trustees for a new franchise in this city.

VALLEJO, CAL.—Randall, Wright & Trowbridge, of Oakland, have applied to the Board of Supervisors for a franchise to construct an electric road to White Sulphur Springs and Benecia.

SAN FRANCISCO, CAL.—After March 1st the United Railroads will pay to the State Harbor Commissioners, for the private privilege of operating its cars on East street, $250 per month.

SPOKANE, WASH.—Plans for electrifying the Chicago, Milwaukee & Puget Sound Railroad, the extension of the Chicago, Milwaukee & St. Paul Railroad west of Mobridge, S. D., have been announced by C. B. Pride, hydraulic engineer in charge, with headquarters in Spokane. Sites for power plants have been purchased on the St. Joe river in Idaho and on the Missoula river in Western Montana. The Idaho division of the Chicago, Milwaukee & Puget Sound Railroad extends from St. Regis, Mont., to St. Joe, Idaho, a distance of 106 miles over the Bitter Root Mountains. The initial capacity of the two plants to be constructed this summer will be 30,000 horsepower. Other sites for plants have been located and will be purchased and developed if the future demands it.

SPOKANE, WASH.—Official announcement is made by M. Hall, president of the Spokane, Wallace & Interstate Railway Company, who is also manager of the Federal Mining & Smelting Company, in the Coeur d'Alenes, that the system including an interurban line from Wallace to Spokane, 85 miles, and branch lines from Wallace to Burke and Mullan, Ida., will be built this year. Work is to begin in June and the line will be rushed to completion. Mr. Hall says the survey follows the Coeur d'Alene valley, crossing the divide at a point between the Coeur d'Alene river and Wolf Lodge bay, near Dudley, Ida. It will skirt Coeur d'Alene lake until the city of Coeur d'Alene, 34 miles east of Spokane, is reached. He is not ready to give out the route for the line to Spokane. He said: "Ample power has been arranged for to operate the new line. We will run two, three or four coach trains each way between Spokane and Wallace and will make the trip in three hours. Trains will be run every two hours out of Wallace to Wardner, Mullan and Burke. It will be in shape to handle an immense freight traffic and will accommodate westbound ore shipments."

WATER.

IMPERIAL, CAL.—The City Trustees propose issuing bonds to the sum of $50,000 for constructing a municipal water system.

EUREKA, CAL.—The Eureka Water Works Company is to spend between $70,000 and $100,000 on improving its plant this year.

NEWMAN, CAL. — The City Trustees propose issuing bonds to the sum of $20,000 to provide for a municipal water system.

OROVILLE, CAL.—W. S. Hanscom and J. H. Kimball have applied for a franchise to construct a water system in the suburbs of Paradise.

SAN LUIS OBISPO, CAL.—The City Council proposes issuing bonds to the amount of $60,000 for improving the water system of this city.

YUBA CITY, CAL.—Bids will be received till March 22, 1909, by City Engineer McMutry for the erection of a municipal water system in this city.

COLUSA, CAL. — The Supervisors have granted the petition of C. K. Sweet asking for the right to lay pipe lines in Williams and Zumwalts.

RHYOLITE, NEV. — The Pioneer Water Company has asked for the right to construct a pipe line from Bryan and Crystal Springs to Pioneer.

SANTA BARBARA, CAL.—Bids have been received for the supplying of materials for the pipe line from south portal of Mission tunnel to Mission reservoir.

LOS ANGELES, CAL.—Harry A. Williams has purchased 40 acres of land near Lindsay, where he will sink a well and install an electric pumping plant.

GRIDLEY, ARIZ.—President Fred G. Moesch, of the Board of Trustees, will receive bids up to March 25, 1909, for furnishing 10,000 feet of two-inch standard wrought-iron pipe.

BISBEE, ARIZ.—Contracts for bids have been awarded to the United States Pipe Company for furnishing cast-iron pipe to be used in constructing the proposed fire protection system.

SAUSALITO, CAL.—Bids will be received till March 22, 1909, by City Clerk John E. Kipp, for furnishing materials and labor for the construction of six water storage tanks in this city.

OAKLAND, CAL.—The suit of Alameda County against the Contra Costa Water Company for delinquent taxes amounting to $110,000 is to be reopened. This week District Attorney Walter Burpee is to take action to remove the injunction which the company secured some time ago.

SAN FRANCISCO, CAL.—The bid of the United States Cast-Iron Pipe & Foundry Company to the Board of Public Works for supplying pipe for the auxiliary fire system in this city is as follows: Pipe to be delivered on cars of a railroad connecting with a transcontinental line, $19.90, $24 and $20.65 a ton, for the different classes of pipe required; pipe to be delivered on a dock alongside of a deep-sea vessel, within reach of the tackle, $21, $25.10 and $21.75, and pipe to be delivered in San Francisco, $33, $37 and $33.75. Assistant Engineer Connick estimates the cost to be upward of $1,475,000. Thomas A. Lewis, representing Glasgow factories, protested to the Mayor and Board of Public Works for an extension of the time in which bids might be received, stating that he could underbid American houses, but it was decided not to delay proceedings any longer.

MODESTO, CAL.—Bonds for the extension of the present water system were carried at the recent municipal election of this city.

WASHINGTON, D. C.—Among the items in the sundry bill as passed by the Senate was $100,000 for the Presidio water supply.

COLTON, CAL.—A contract for about 9,000 feet of pipe for the city water system has been awarded to the Macy Manufacturing Company, of Los Angeles.

SAN FRANCISCO, CAL.—The finance committee of the Board of Supervisors has agreed to set aside $10,000 of the present bond issue for the proposed auxiliary water system.

LOS ANGELES, CAL.—J. H. McCabe, of Phoenix, Ariz., has purchased the entire stock of the Strawberry Park Water Company and announces that improvements in extension of service will begin at once.

SAN FRANCISCO, CAL.—N. H. Falk, of Arcata, Cal., is now in this city securing machinery and apparatus for the new water system and pumping station which is to be built in addition to the present system.

LOS ANGELES, CAL.—In the suit of the farmers of the Yucalpe watershed in San Bernardino county against the Yucalpe Land & Water Company, Judge Hutton decided in the farmers' favor, granting them the right to take 225 inches of water from the watershed.

ALAMEDA, CAL.—City Attorney Simpson has been instructed by the Board of Health to draw up an ordinance compelling the People's Water Company to supply that city with water from one well, instead of from the various sources, so that a pure water supply will be insured.

LOS ANGELES, CAL. — Contracts on bids have been awarded to Crane Company, of Los Angeles, for furnishing 16,000 pounds of pipe fittings, at $1,047.64 f. o. b. Los Angeles; to the Union Hardware & Metal Company for "T" and angle iron, at from $1.49 to $1.64 a hundred pounds, f. o. b. Pittsburg.

REDLANDS, CAL. — Bids have been received by the Board of Directors of the West Redlands Water Company for pipe for a pipe line of approximately the following lengths and dimensions: 10,000 feet of 18-inch vitrified pipe, 1,000 feet of 18-inch steel pipe, 2,000 feet of 12-inch vitrified pipe.

HEMET, CAL.—The Moreno Irrigation Company has awarded a contract to Frank Kimball, of Los Angeles, for a pumping plant, which includes a 250-horsepower engine, triplex pump and air compressor. A contract has also been let to the Bapp-Gifford Company, of Los Angeles, for the laying of seven miles of pipe line on the company's lands.

SAN JUAN, CAL.—The Town Board has awarded contracts on bids for the laying of pipes for the water system to Brown & Chappell, of Hollister, for the laying of 3,000 feet of four-inch cast-iron pipe at 5 cents per foot; to M. Mackenzie for the laying of screwed pipe at 1½ cents per foot, and for the laying of 10,200 feet of six-inch wood pipe at 1 1-3 cents per foot.

SAN FRANCISCO, CAL.—Chief Engineer Manson has received a communication from Secretary Garfield and Secretary Wilson, at Washington, D. C., granting permission for canal rights of way, two power houses, and the right to clear for the dam site at Lake Eleanor. The communication also stated that construction work could begin at once. Although Congress failed to confirm the grants at its recent session, the measures taken by the Departments of Interior and Agriculture are said to be as effective as if granted by Congress. The canal rights granted include the diversion canal from Cherry creek to Lake Eleanor; the canal from Lake Eleanor to the main canal, and the Tuolumne main canal. These canals will run in part through Yosemite Park, part through segregated lands attached to the forest reserve, and through the forest reserve itself. The exact sites which have been chosen for the two power houses has not been made public.

STOCKTON, CAL. — President John A. Britton, of the Stockton Water Company, announces that $30,000 is to be spent during the coming year in increasing the capacity of the plant and bettering the service. Two new wells are now being bored at Station No. 1, and two are being sunk at Station No. 2. A reinforced concrete building at the plant in the northwestern portion of the city to to be commenced on soon. New six-inch mains on San Joaquin street are now being laid, so that water can be furnished from either plant to patrons.

OIL.

SANTA BARBARA, CAL.—The Mayor and citizens of Santa Barbara have filed a protest with the Secretary of War against the Union Oil Company. The complaint is against a permit which the oil company desire to extend their pipe lines into the ocean near Santa Barbara. The citizens state that if this is granted it will ruin the beaches and thus injure the reputation of the city.

BAKERSFIELD, CAL.—Owing to the cost of living being advanced to 7½ cents per day, while their wages were increased to but 5 cents, some sixty or seventy of the employes of the Santa Fe's oil department at Midway left their jobs this week. The wages received by the men were $2.50 a day and board, and because their wages changed to $3.50 per day without board they were dissatisfied.

SAN FRANCISCO, CAL.—Owing to the fact that steps are being taken by Congress to abolish the present tariff on crude petroleum, the Mid-Continent Oil & Gas Producers' Association, of Tusla, Okla., has sent letters to all oil men, urging united action to prevent the removal of tariff.

BAKERSFIELD, CAL.—President L. P. St. Clair, of the Independent Oil Producers' Agency, says: "The present production of oil a little more than equals the present consumption. The surplus each day is approximately 6,000 barrels. There is less than six months' supply in the State on top of the ground."

BAKERSFIELD, CAL.—The Twenty-five Oil Company, at Midway, has let a contract to the Lacey Company, of Los Angeles, for the construction of 25,000-barrel steel storage tanks. A pipe system is to be installed to connect the various wells with the storage tanks.

ROSEMARY, CAL.—The Union Oil Company has reached a depth of 4,940 feet at its well here and is finding strong traces of petroleum of light gravity. Six and five-eighths casing is being used at this depth. Within but a hundred feet of this well is one that is producing oil at less than half this depth. This phenomenon cannot be accounted for.

FINANCIAL.

SAN FRANCISCO, CAL.—The California Stock & Oil Exchange, in its monthly statement of dividends paid by oil companies of California in February, reports the following: The Amalgamated Oil, $50,000; total, $950,000; Brookshire, $10,000—$352,500; Caribou, $20,175.75—$438,246.99; Euclid, $3,500—$78,500; Claremont, $4,500—$210,500; Columbia, $9,992.66—$184,863.62; Esperanza, $1,600—$25,450; Four, $3,000—$195,000; Junction, $2,500—$10,000; Kern River, $2,000—$98,000; Home, $2,000—$448,000; Illinois Crude, $2,000—$54,000; Linda Viata, $3,838.50—$38,585; Lucille, $2,670.40—$18,692.80; Peerless, $6,000—$759,000; Piedmont, $3,890—$15,207.30; Penal, $22,500—$662,341; Royalty, $800—$2,400; S. F. and McKittrick, $15,000—$120,000; Sauer Dough, $9,975—$359,100; Union, $117,711—$4,774,094.15; United Petroleum, $40,375.50—$1,654,078.43, and Wabash, $3,000—$84,000. The total dividends paid by the above companies in February amounted to $337,028.81.